LONG BEACH AIRPORT TERMINAL IMPROVEMENTS

APPENDIX F
TECHNICAL REPORT: NOISE ANALYSIS

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Table of Contents

INTRODUCTION

This report is divided into 6 sections plus this introduction. Section 1 presents background information on sound, noise, and how noise affects people. Section 2 describes the methodology used for this study. Section 3 describes existing noise environment and the Threshold of Significance used in this analysis. Section 4 describes potential future with optimized flight levels noise levels. Section 5 presents a discussion of potential mitigation measures. Section 6 contains the list of references.

1.0 BACKGROUND INFORMATION

1.1 INTRODUCTION

This section presents background information on the characteristics of noise. Noise analyses involve the use of technical terms that are used to describe aviation noise as well as noise from other sources such as motor vehicle traffic and construction equipment. This section will give the reader an understanding of the metrics and methodologies used to assess noise impacts. This section is divided as follows:

- *Properties of sound that are important for technically describing sound*
- *Acoustic factors influencing human subjective response to sound.*
- *Potential disturbances to humans and health effects due to sound.*
- *Sound rating scales used in this study*
- Summary of noise assessment criteria

1.2 CHARACTERISTICS OF SOUND

Sound Level and Frequency. Sound can be technically described in terms of the sound pressure (amplitude) and frequency (similar to pitch). Sound pressure is a direct measure of the magnitude of a sound without consideration for other factors that may influence its perception.

The range of sound pressures that occur in the environment is so large that it is convenient to express these pressures as sound pressure levels on a logarithmic scale that compresses the wide range of sound pressures to a more usable range of numbers. The standard unit of measurement of sound is the Decibel (dB) that describes the pressure of a sound relative to a reference pressure.

The frequency (pitch) of a sound is expressed as Hertz (Hz) or cycles per second. The normal audible frequency for young adults is 20 Hz to 20,000 Hz. Community noise, including aircraft and motor vehicles, typically ranges between 50 Hz and 5,000 Hz. The human ear is not equally sensitive to all frequencies, with some frequencies judged to be louder for a given signal than others. As a result of this, various methods of frequency weighting have been developed. The most common weighting is the A-weighted noise curve (dBA). The A-weighted decibel scale (dBA) performs this compensation by discriminating against frequencies in a manner approximating the sensitivity of the human ear. In the A-weighted decibel, everyday sounds normally range from 30 dBA (very quiet) to 100 dBA (very loud). Most community noise analyses are based upon the A-weighted decibel scale. Examples of various sound environments, expressed in dBA, are presented in Exhibit 1-1.

Propagation of Noise. Outdoor sound levels decrease as the distance from the source increases, and as a result of wave divergence, atmospheric absorption and ground attenuation. Sound radiating from a source in a homogeneous and undisturbed manner travels in spherical waves. As the sound wave travels away from the source, the sound energy is dispersed over a greater area decreasing the sound power of the wave. Spherical spreading of the sound wave reduces the noise level at a rate of 6 dB per doubling of the distance.

Atmospheric absorption also influences the levels received by the observer. The greater the distance traveled, the greater the influence of the atmosphere and the resultant fluctuations. Atmospheric absorption becomes important at distances of greater than 1000 feet. The degree of absorption varies depending on the frequency of the sound as well as the humidity and temperature of the air. For example, atmospheric absorption is lowest (i.e., sound carries farther) at high humidity and high temperatures. Schematic atmospheric effects diagrams are presented in Exhibit 1-2. Turbulence and gradients of wind, temperature and humidity play a significant role in determining the propagation of sound over a large distance. At short distances between the source and receiver atmospheric effects are minimal. Certain conditions, such as inversions, can channel or focus the sound waves resulting in higher noise levels than would result from simple spherical spreading. Absorption effects in the atmosphere vary with frequency. The higher frequencies are more readily absorbed than the lower frequencies. Over large distances, the lower frequencies become the dominant sound as the higher frequencies are attenuated.

Duration of Sound. Annoyance from a noise event increases with increased duration of the noise event, i.e., the longer the noise event, the more annoying it is. The "*effective duration*" of a sound is the time between when a sound rises above the background sound level until it drops back below the background level. Psycho-acoustic studies have determined the relationship between duration and annoyance and the amount a sound must be reduced to be judged equally annoying for increased duration. Duration is an important factor in describing sound in a community setting.

The relationship between duration and noise level is the basis of the equivalent energy principal of sound exposure. Reducing the acoustic energy of a sound by one half results in a 3 dB reduction. Doubling the duration of the sound increases the total energy of the event by 3 dB. This equivalent energy principal is based upon the premise that the potential for a noise to impact a person is dependent on the total acoustical energy content of the noise.[1] Defined in subsequent sections of this study, noise metrics such as CNEL, DNL, LEQ and SENEL are all based upon the equal energy principle.

Change in Noise. The concept of change in ambient sound levels can be understood with an explanation of the hearing mechanism's reaction to sound. The human ear is a far better detector of relative differences in sound levels than absolute values of levels. Under controlled laboratory conditions, listening to a steady unwavering pure tone sound that can be changed to slightly different sound levels, a person can just barely detect a sound level change of approximately one decibel for sounds in the mid-frequency region. When ordinary noises are heard, a young healthy ear can detect changes of two to three decibels. A five decibel change is readily noticeable while a 10 decibel change is judged by most

dB(A)	OVER-ALL LEVEL Sound Pressure Level Reference: 0.0002 Microbars	COMMUNITY (Outdoor)	HOME OR INDUSTRY	LOUDNESS Human Judgement of Different SoundLevels
130		Military Jet Aircraft Take-Off With After-burner From Aircraft Carrier @ 50 Ft. (130)	Oxygen Torch (121)	120 dB(A) 32 Times as Loud
120 110	UNCOMFORTABLY LOUD	Concord Takeoff (113)*	Riveting Machine (110) Rock-N-Roll Band (108-114)	110 dB(A) 16 Times as Loud
100		Boeing 747-200 Takeoff (101)*		100 dB(A) 8 Times as Loud
90	VERY LOUD	Power Mower (96) DC-10-30 Takeoff (96)* Motorcycle @25 Ft. (90)	Newspaper Press (97)	90 dB(A) 4 Times as Loud
80		Car Wash @ 20 Ft. (89) Boeing 727 w/ Hushkit Takeoff (96)* Diesel Truck, 40 MPH @ 50 Ft. (84) Diesel Train, 45 MPH @ 100 Ft. (83)	Food Blender (88) Milling Machine (85) Garbage Disposal (80)	80 dB(A) 2 Times as Loud
70	MODERATELY LOUD	High Urban Ambient Sound (80) Passenger Car, 65 MPH @ 25 Ft. (77) Freeway @ 50 Ft. From Pavement) Edge, 10:00 AM (76 +or- 6) Boeing 757 Takeoff (76)*	Living Room Music (76) TV-Audio, Vacuum Cleaner	70 dB(A)
60		Propeller Airplane Takeoff (67)* Air Conditioning Unit @ 100 Ft. (60)	Cash Register @ 10 Ft. (65-70) Electric Typewriter @ 10 Ft. (64) Dishwasher (Rinse) @ 10 Ft. (60) Conversation (60)	60 dB(A) 1/2 as Loud
50	QUIET	Large Transformers @ 100 Ft. (50)		50 dB(A) 1/4 as Loud
40		Bird Calls (44) Lower Limit Urban Ambient Sound (40)		40 dB(A) 1/8 as Loud
20	JUST AUDIBLE	Desert at Night (dB[A] Scale Interrupted)		
10	THRESHOLD OF HEARING			

Numbers in Parentheses are the A-Scale Weighted Sound Levels for that Noise Event
****Aircraft takeoff noise measured 6,500 meters from beginning of takeoff roll***

SOURCE: Leo L. Beranek "Noise and Vibration Control," 1971
*Aircraft Levels From FAA Advisory Circular AC-36-3G

Exhibit 1-1
Examples of Various Sound Levels
Long Beach Airport Terminal Improvement EIR

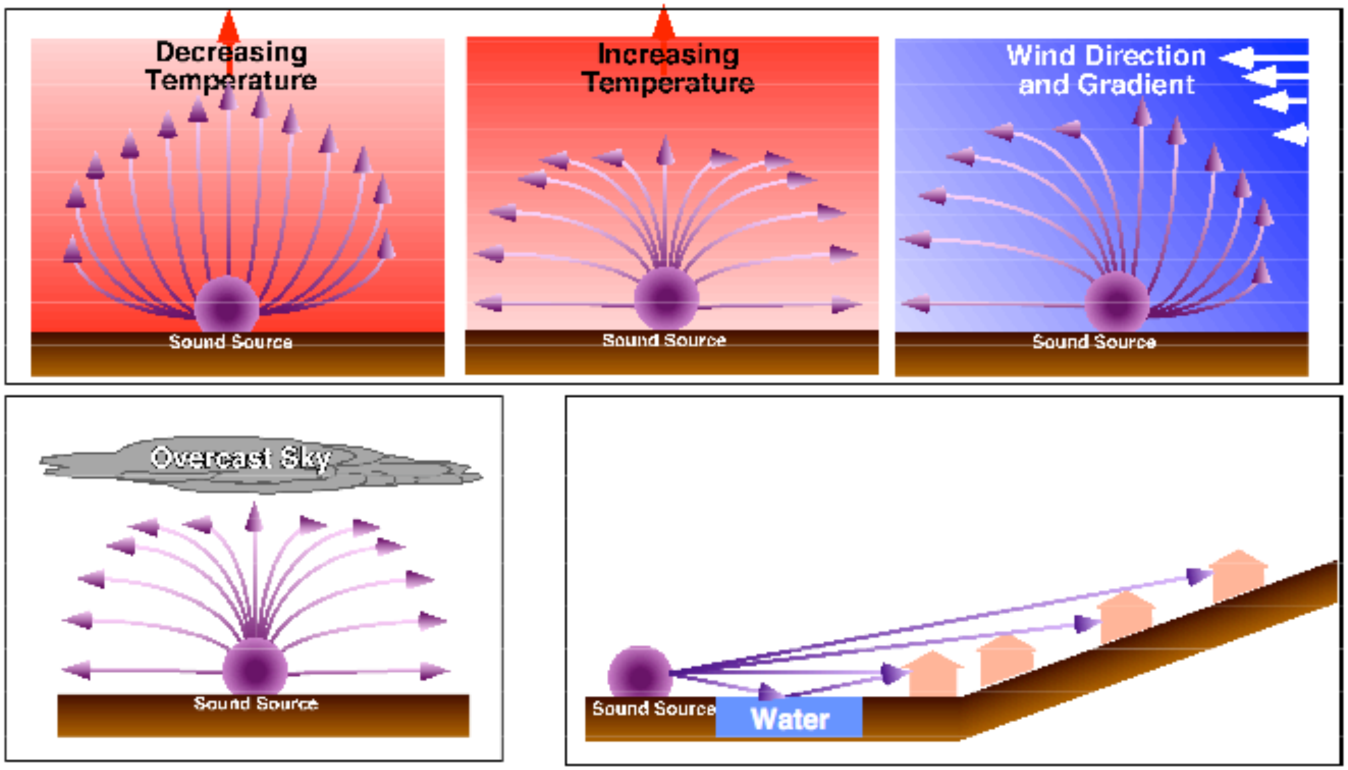


Exhibit 1-2
The Effect of Weather on Sound Propagation

Long Beach Airport Terminal Improvement EIR people as a doubling or a halving of the loudness of the sound. It is typical in environmental documents to consider a 3 dB change as potentially discernable.

Masking Effect. The ability of one sound to limit a listener from hearing another sound is known as the masking effect. The presence of one sound effectively raises the threshold of audibility for the hearing of a second sound. For a signal to be heard, it must exceed the threshold of hearing for that particular individual and exceed the masking threshold for the background noise.

The masking characteristics of sound depend on many factors including the spectral (frequency) characteristics of the two sounds, the sound pressure levels and the relative start time of the sounds. Masking effect is greatest when the frequencies of the two sounds are similar or when low frequency sounds mask higher frequency sounds. High frequency sounds do not easily mask low frequency sounds.

1.3 FACTORS INFLUENCING HUMAN RESPONSE TO SOUND

Many factors influence sound perception and annoyance. This includes not only physical characteristics of the sound but also secondary influences such as sociological and external factors. Molino, in the *Handbook of Noise Control*[2] describes human response to sound in terms of both acoustic and non-acoustic factors. These factors are summarized in Table 1-1.

Sound rating scales are developed in reaction to the factors affecting human response to sound. Nearly all of these factors are relevant in describing how sounds are perceived in the community. Many non-acoustic parameters play a prominent role in affecting individual response to noise. Background sound, an additional acoustic factor not specifically listed, is also important in describing sound in rural settings. Fields, [3] in his analysis of the effects of personal and situational variables on noise annoyance, has identified a clear association of reported annoyance and various other individual perceptions or beliefs. In particular, Fields stated:

> *"There is therefore firm evidence that noise annoyance is associated with: (1) the fear of an aircraft crashing or of danger from nearby surface transportation; (2) the belief that aircraft noise could be prevented or reduced by designers, pilots or authorities related to airlines; and (3) an expressed sensitivity to noise generally."*

Thus, it is important to recognize that non-acoustic factors such as the ones described above as well as acoustic factors contribute to human response to noise.

Table 1-1
Factors that Affect Individual Annoyance to Noise

Primary Acoustic Factors
Sound Level
Frequency
Duration

Secondary Acoustic Factors
Spectral Complexity
Fluctuations in Sound Level
Fluctuations in Frequency
Rise-time of the Noise
Localization of Noise Source

Non-acoustic Factors
Physiology
Adaptation and Past Experience
How the Listener's Activity Affects Annoyance
Predictability of When a Noise will Occur
Is the Noise Necessary?
Individual Differences and Personality

Source: C. Harris, 1979

1.4 SOUND RATING SCALES

The description, analysis, and reporting of community sound levels is made difficult by the complexity of human response to sound and myriad sound-rating scales and metrics developed to describe acoustic effects. Various rating scales approximate the human subjective assessment to the "loudness" or "noisiness" of a sound. Noise metrics have been developed to account for additional parameters such as duration and cumulative effect of multiple events.

Noise metrics are categorized as single event metrics and cumulative metrics. Single event metrics describe the noise from individual events, such as one aircraft flyover. Cumulative metrics describe the noise in terms of the total noise exposure throughout the day. Noise metrics used in this study are summarized below:

Single Event Metrics

- **Frequency Weighted Metrics (dBA).** In order to simplify the measurement and computation of sound loudness levels, frequency weighted networks have obtained wide acceptance. The A-weighting (dBA) scale has become the most prominent of these scales and is widely used in community noise analysis. Its advantages are that it has shown good correlation with community response and is easily measured. The metrics used in this study are all based upon the dBA scale.

- **Maximum Noise Level.** The highest noise level reached during a noise event is, not surprisingly, called the "Maximum Noise Level," or Lmax. For example, as an aircraft approaches, the sound of the aircraft begins to rise above ambient noise levels. The closer the aircraft gets the louder it is until the aircraft is at its closest point directly overhead. Then as the aircraft passes, the noise level decreases until the sound level again settles to ambient levels. Such a history of a flyover is plotted at the top of Exhibit 1-3. It is this metric to which people generally instantaneously respond when an aircraft flyover occurs.

• **Single Event Noise Exposure Level (SENEL) or Sound Exposure Level (SEL).** Another metric that is reported for aircraft flyovers is the Single Event Noise Exposure Level (SENEL). This metric is essentially equivalent to the Sound Exposure (SEL) metric. It is computed from dBA sound levels. Referring again to the top of Exhibit 1-3, the shaded area, or the area within 10 dB of the maximum noise level, is the area from which the SENEL is computed. The SENEL value is the integration of all the acoustic energy contained within the event. Speech and sleep interference research can be assessed relative to Single Event Noise Exposure Level data.

The SENEL metric takes into account the maximum noise level of the event and the duration of the event. For aircraft flyovers, the SENEL value is typically about 10 dBA higher than the maximum noise level. Single event metrics are a convenient method for describing noise from individual aircraft events. This metric is useful in that airport noise models contain aircraft noise curve data based upon the SENEL metric. In addition, cumulative noise metrics such as LEQ, CNEL and DNL can be computed from SENEL data.

Cumulative Metrics

Cumulative noise metrics assess community response to noise by including the loudness of the noise, the duration of the noise, the total number of noise events and the time of day these events occur into one single number rating scale.

• **Equivalent Noise Level (Leq).** Leq is the sound level corresponding to a steady-state A-weighted sound level containing the same total energy as several SEL events during a given sample period. Leq is the "energy" average noise level during the time period of the sample. It is based on the observation that the potential for noise annoyance is dependent on the total acoustical energy content of the noise. This is graphically illustrated in the middle graph of Exhibit 1-3. Leq can be measured for any time period, but is typically measured for 15 minutes, 1 hour or 24-hours. Leq for a one hour period is used by the Federal Highway Administration for assessing highway noise impacts. Leq for one hour is called Hourly Noise Level (HNL) in the California Airport Noise Regulations[4] and is used to develop Community Noise Equivalent Level (CNEL) values for aircraft operations.

• **Community Noise Equivalent Level (CNEL).** CNEL is a 24-hour, time-weighted energy average noise level based on the A-weighted decibel. It is a measure of the overall noise experienced during an entire day. The term “time-weighted” refers to the penalties attached to noise events occurring during certain sensitive time periods. In the CNEL scale, noise occurring between the hours of 7 pm and 10 pm is penalized by approximately 5 dB. This penalty accounts for the greater potential for noise to cause communication interference during these hours, as well as typically lower ambient noise levels during these hours. Noise that takes place during the night (10 pm to 7 am) is penalized by 10 dB. This penalty was selected to attempt to account for the higher sensitivity to noise in the nighttime and the expected further decrease in background noise levels that typically occur in the nighttime.

CNEL is graphically illustrated in the bottom of Exhibit 1-3. Examples of various noise environments in terms of CNEL are presented in Exhibit 1-4. CNEL is specified for use in the California Airport Noise Regulations and is used by local planning agencies in their General Plan Noise Element for land use compatibility planning.

• **Day Night Noise Level (DNL).** The DNL index is very similar to CNEL but does not include the evening (7 pm to 10 pm) penalty that is included in CNEL. It does include the nighttime (10 pm to 7 am) penalty. Typically DNL is about 1 dB lower than CNEL, although the difference may be greater if there is an abnormal concentration of noise events in the 7 to 10 pm time period. DNL is specified by the FAA for airport noise assessment and by the Environmental Protection Agency (EPA) for community noise and airport noise assessment. The FAA guidelines (described later) allow for the use of CNEL as a substitute to DNL.

1.5 EFFECTS OF NOISE ON HUMANS

Noise, often described as unwanted sound, is known to have several adverse effects on humans. From these known adverse effects of noise, criteria have been established to help protect the public health and safety and prevent disruption of certain human activities. These criteria are based on effects of noise on people such as hearing loss (not a factor with typical community noise), communication interference, sleep interference, physiological responses and annoyance. Each of these potential noise impacts on people are briefly discussed in the following narrative:

• **Hearing Loss** is generally not a concern in community noise problems, even very near a major airport or a major freeway. The potential for noise induced hearing loss is more commonly associated with occupational noise exposures in heavy industry, very noisy work environments with long term exposure, or certain very loud recreational activities such as target shooting, motorcycle or car racing, etc. The Occupational Safety and Health Administration (OSHA) identifies a noise exposure limit of 90 dBA for 8 hours per day to protect from hearing loss (higher limits are allowed for shorter duration exposures). Noise levels in neighborhoods, even in very noisy neighborhoods, are not sufficiently loud to cause hearing loss.

• Communication Interference is one of the primary concerns in environmental noise problems. Communication interference includes speech interference and interference with activities such as watching television. Normal conversational speech is in the range of 60 to 65 dBA and any noise in this range or louder may interfere with speech. There are specific methods of describing speech interference as a function of distance between speaker and listener and voice level. Exhibit 1-5 shows the relation of quality of speech communication with respect to various noise levels.

• **Sleep Interference** is a major noise concern in noise assessment and, of course, is most critical during nighttime hours. Sleep disturbance is one of the major causes of annoyance due to community noise. Noise can make it difficult to fall asleep,

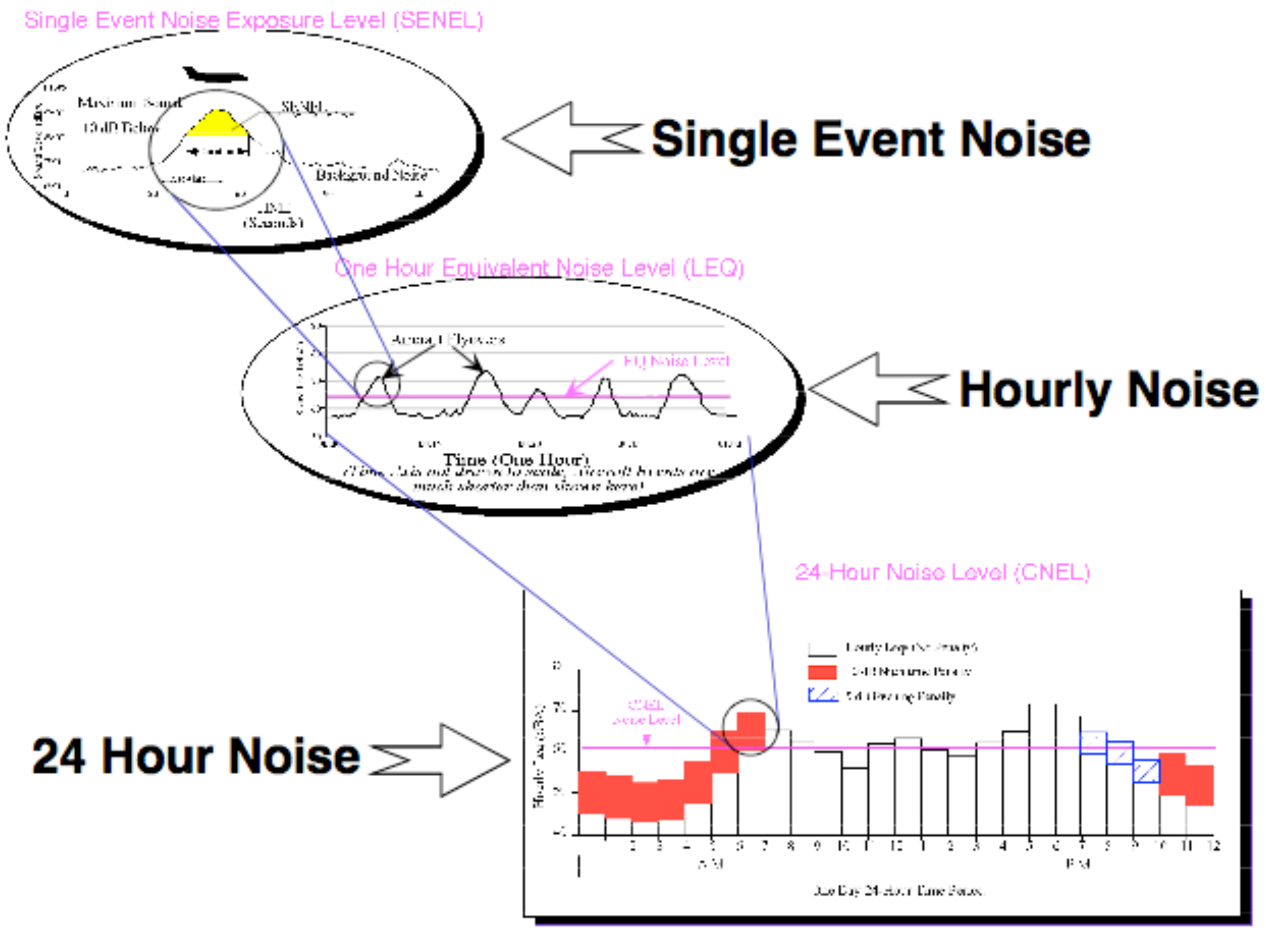
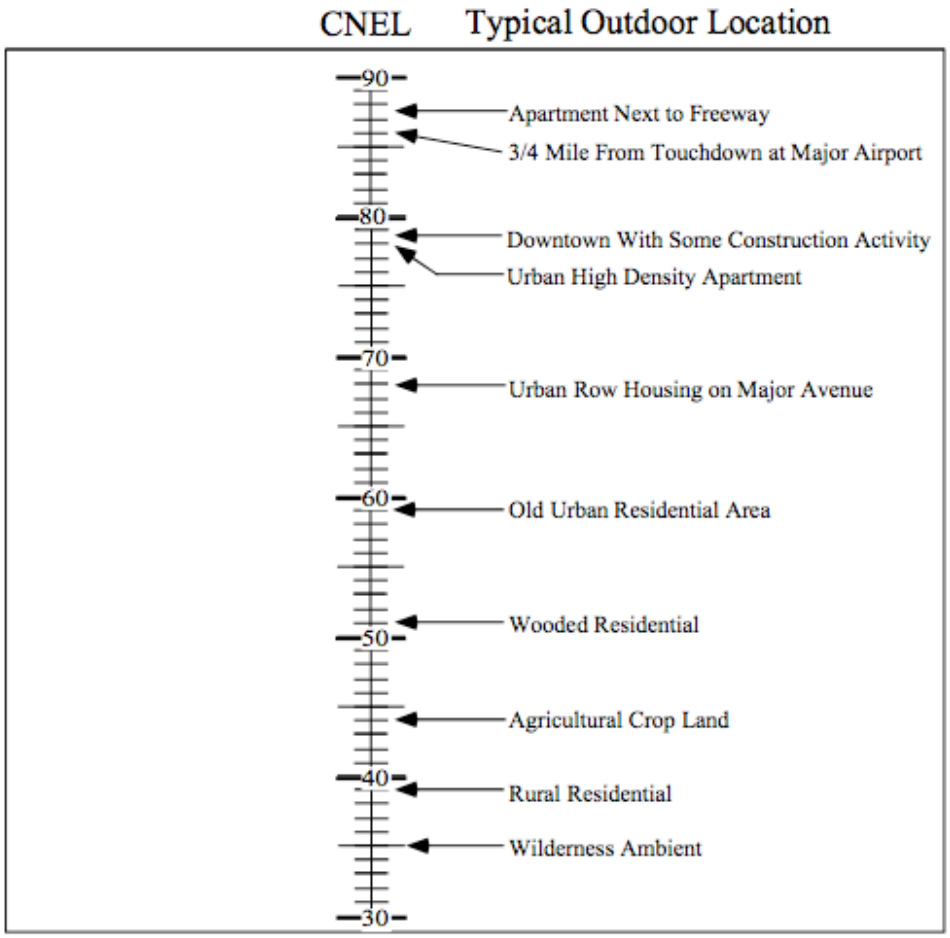


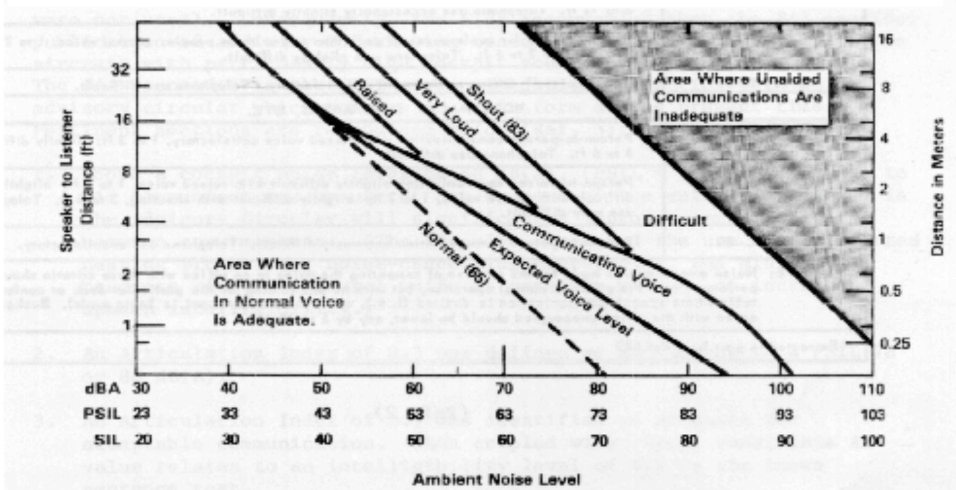
Exhibit 1-3
Single and Cumulative Noise Metric Definitions

Long Beach Airport Terminal Improvement EIR



Source: Adapted from "Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare With an Adequate Margin of Safety", EPA, 1974

Exhibit 1-4
Typical Outdoor Noise Levels in Terms of CNEL
Long Beach Airport Terminal Improvement EIR



Permissible Distance Between a Speaker and Listeners for Specified Voice Levels and Ambient Noise Levels

(The Levels in Parantheses Refer to Voice Levels Measured One Meter From the Mouth.)

Exhibit 1-5
Speech Interference with Different Background Noise

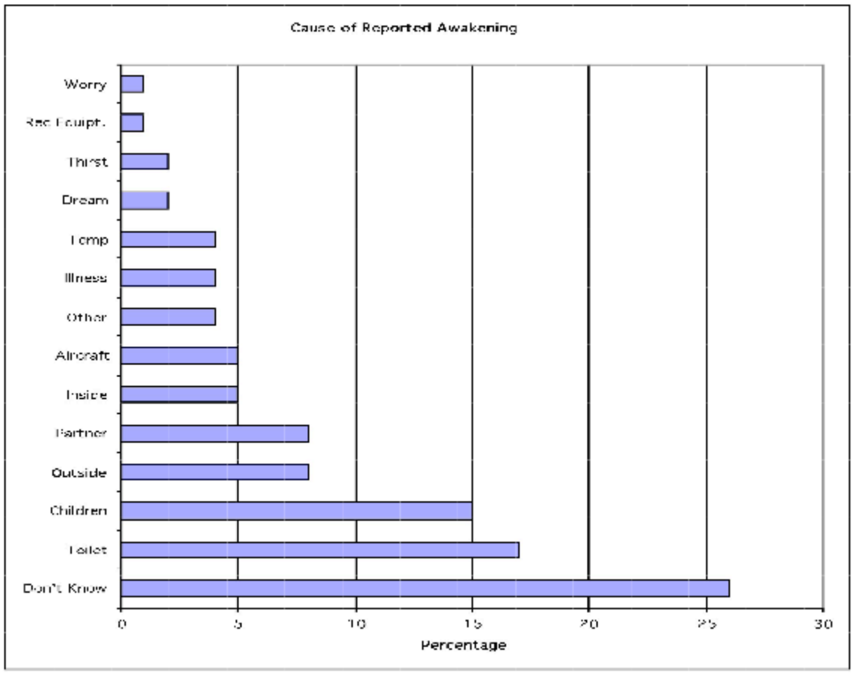
Long Beach Airport Terminal Improvement EIR

create momentary disturbances of natural sleep patterns by causing shifts from deep to lighter stages and cause awakening. Noise may even cause awakening that a person may or may not be able to recall.

Extensive research has been conducted on the effect of noise on sleep disturbance. Recommended values for desired sound levels in residential bedroom space range from 25 to 45 dBA with 35 to 40 dBA being the norm. Some years ago (1981) The National Association of Noise Control Officials[5] published data on the probability of sleep disturbance with various single event noise levels. Based on laboratory experiments conducted in the 1970's, this data indicated noise exposure, at 75 dBA interior noise level event will cause noise induced awakening in 30 percent of the cases.

However, recent research from England[6] [7] has shown that the probability for sleep disturbance is less than what had been reported in earlier research. These recent field studies conducted during the 1990's and using new sophisticated techniques indicate that awakenings can be expected at a much lower rate than had been expected based on earlier laboratory studies. This research showed that once a person was asleep, it is much more unlikely that they will be awakened by a noise. The significant difference in the recent English study is the use of actual in-home sleep disturbance patterns as opposed to laboratory data that had been the historic basis for predicting sleep disturbance. Some of this research has been criticized because it was conducted in areas where subjects had become habituated to aircraft noise. On the other hand, some of the earlier laboratory sleep studies had been criticized because of the extremely small sample sizes of most laboratory studies and because the laboratory was not necessarily a representative sleep environment. The 1994 British sleep study compared the various causes of sleep disturbance using in home sleep studies. This field study assessed the effects of nighttime aircraft noise on sleep in 400 people (211 women and 189 men; 20-70 years of age; one per household) habitually living at eight sites adjacent to four U.K. airports, with different levels of night flying. The main finding was that only a minority of aircraft noise events affected sleep, and, for most subjects, that domestic and other non-aircraft factors had much greater effects. As shown in the Exhibit 1-6, aircraft noise was a minor contributor among a host of other factors that lead to awakening response.

The Federal Interagency Committee on Noise (FICON) in 1992 in a document entitled *Federal Interagency Review of Selected Airport Noise Analysis Issues* [8] recommended an interim dose-response curve for sleep disturbance based on laboratory studies of sleep disturbance. In June of 1997, the Federal Interagency Committee on Aviation Noise (FICAN) updated the FICON recommendation with an updated curve based on the more recent in-home sleep disturbance studies that show lower rates of awakening compared to the laboratory studies[9]. The FICAN recommended a curve based on the upper limit of the data presented and therefore considers the curve to represent the "maximum percent of the exposed population expected to be behaviorally awakened," or the "maximum awakened." The FICAN recommendation is shown on Exhibit 1-7. This is a very conservative approach. A more common statistical curve for the data points reflected in Exhibit 1-7, for example, would indicate a 10% awakening rate at a level of approximately 100 dB SENEL, while the "maximum awakened" curve reflected in Exhibit 1-7 shows the 10% awakening rate being reached at 80 dB SENEL. (The full FICAN report can be found on the internet at www.fican.org.)



(Total awakenings = 6,457. Each subject could have reported more than one awakening each night)

Exhibit 1-6
Causes and Prevalence of All Awakenings
Long Beach Airport Terminal Improvement EIR

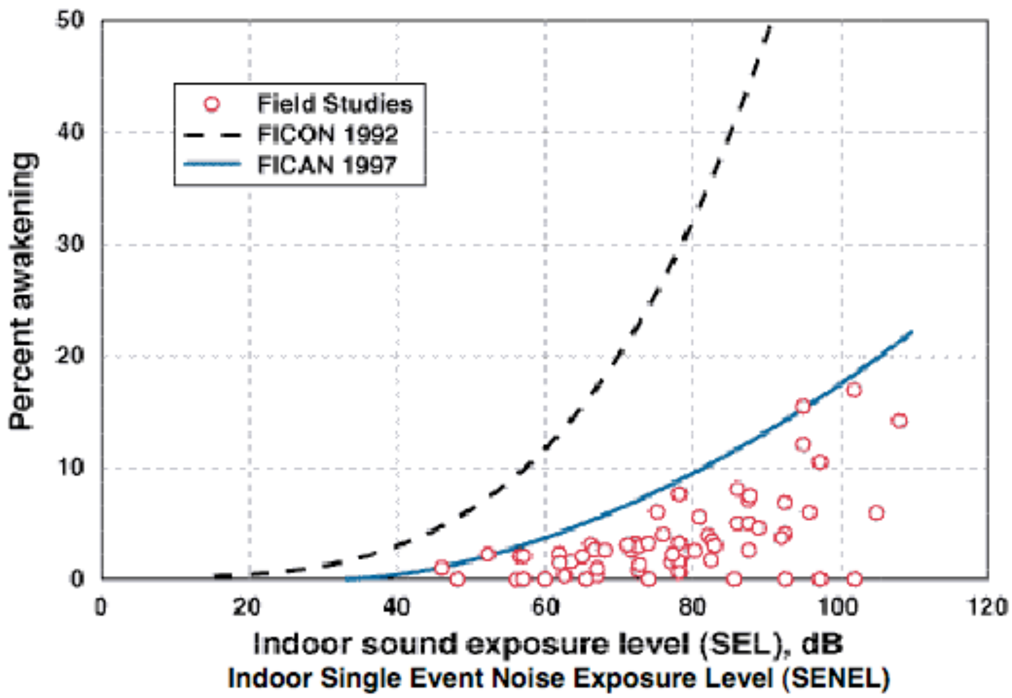


Exhibit 1-7
Sleep Disturbance Research
Long Beach Airport Terminal Improvement EIR

• **Physiological Responses** are those measurable effects of noise on people that are realized as changes in pulse rate, blood pressure, etc. While such effects can be induced and observed, the extent is not known to which these physiological responses cause harm or are a sign of harm. Generally, physiological responses are a reaction to a loud short term noise such as a rifle shot or a very loud jet over flight.

Health effects from noise have been studied around the world for nearly thirty years. Scientists have attempted to determine whether high noise levels can adversely affect human health-apart from auditory damage that is amply understood. These research efforts have covered a broad range of potential impacts from cardiovascular response to fetal weight and mortality. Yet while a relationship between noise and health effects seems plausible, it has yet to be convincingly demonstrated--that is, shown in a manner that can be repeated by other researchers while yielding similar results.

While annoyance and sleep/speech interference have been acknowledged, health effects, if they exist, are associated with a wide variety of other environmental stressors. Isolating the effects of aircraft noise alone as a source of long term physiological change has proved to be almost impossible. In a review of 30 studies conducted worldwide between 1993 and 1998,[10] a team of international researchers concluded that, while some findings suggest that noise can affect health, improved research concepts and methods are needed to verify or discredit such a relationship. They called for more study of the numerous environmental and behavioral factors than can confound, mediate or moderate survey findings. Until science refines the research process, a direct link between aircraft noise exposure and non-auditory health effects remains to be demonstrated. The World Health Organization (WHO)[11] has made quite specific findings on the potential of environmental noise to cause health impacts:

> *"The overall conclusion is that cardiovascular effects are associated with long-term exposure to LAeq, 24h values in the range of 65–70 dB or more, for both air- and road-traffic noise. However, the associations are weak and the effect is somewhat stronger for ischemic heart disease than for hypertension."*
>
> *"Other observed psychophysiological effects, such as changes in stress hormones, magnesium levels, immunological indicators, and gastrointestinal disturbances are too inconsistent for conclusions to be drawn about the influence of noise pollution."*
> *[Source: WHO Guidelines, Section 3.5, Cardiovascular and Physiological Effects]*

In other words, the World Health Organization believes that health effects do not occur at noise levels less than 65 CNEL.

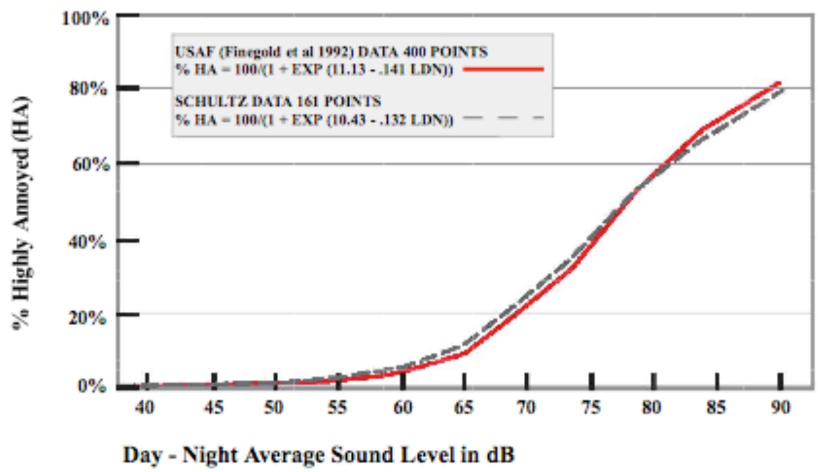
• **Annoyance** is the most difficult of all noise responses to describe. Annoyance is a very individual characteristic and can vary widely from person to person. What one person considers tolerable can be quite unbearable to another of equal hearing capability. The level of annoyance, of course, depends on the characteristics of the noise (i.e.; loudness, frequency, time, and duration), and how much activity interference (e.g. speech interference and sleep interference) results from the noise. However, the level of annoyance is also a function of the attitude of the receiver. Personal sensitivity to noise varies widely. It has been estimated that 2 to 10 percent of the population is highly susceptible to annoyance from any noise not of their own making, while approximately 20 percent are unaffected by noise. Attitudes are affected by the relationship between the person and the noise source (Is it our dog barking or the neighbor's dog?). Whether we believe that someone is trying to abate the noise will also affect our level of annoyance.

Annoyance levels have been correlated to CNEL levels. Exhibit 1-8 relates DNL noise levels to community response from two of these surveys. One of the survey curves presented in Exhibit 1-8 is the well-known Schultz curve, developed by Theodore Schultz [8]. It displays the percent of a populace that can be expected to be annoyed by various DNL (CNEL in California) values for residential land use with outdoor activity areas. At 65 dB DNL the Schultz curve predicts approximately 14% of the exposed population reporting themselves to be "highly annoyed." At 60 dB DNL this decreases to approximately 8% of the population.

The Schultz curve and recent updates include data having a very wide range of scatter with communities near some airports reporting much higher percentages of population highly annoyed at these noise exposure levels. While the precise reasons for this increased noise sensitivity were not identified, it is possible that non-acoustic factors, including political or the socio-economic status of the surveyed population may have played an important role in increasing the sensitivity of this community during the period of the survey. Annoyance levels have never been correlated statistically to single event noise exposure levels in airport related studies.

• **School Room Effects**. Interference with classroom activities and learning from aircraft noise is an important consideration and the subject of much recent research. Studies from around the world indicate that vehicle traffic, railroad and aircraft noise can have adverse effects on reading ability, concentration, motivation, and long term learning retention. A complicating factor in this research is the extent of background noise from within the classroom itself. The studies indicating the most adverse effects examine cumulative noise levels equivalent to 65 CNEL or higher and single event maximum noise levels ranging from 85 to 95 dBA. In other studies the level of noise is unstated or ambiguous. According to these studies, a variety of adverse school room effects can be expected from *interior* noise levels equal to or exceeding 65 CNEL and or 85 dBA SEL.

Some interference with classroom activities can be expected with noise events that interfere with speech. As discussed in other sections of this report, speech interference begins at 65 dBA, that is the level of normal conversation. Typical construction attenuates outdoor noise by 20 dBA with windows closed and 12 dBA with windows open. Thus some interference of classroom activities can be expected at outdoor levels of 77 to 85 dBA.



USAF	0.41	0.831	1.66	3.31	6.48	12.29	22.1	36.47	53.74	70.16	82.64
SCHULTZ	0.576	1.11	2.12	4.03	7.52	13.59	23.32	37.05	53.25	68.78	81.0

CALCULATED % HIGHLY ANNOYED (HA) POINTS

Source: Ficon 1992

Exhibit 1-8

Example of Community Reaction to Aircraft Noise

Long Beach Airport Terminal Improvement EIR

1.6 NOISE/LAND USE COMPATIBILITY GUIDELINES

Noise metrics quantify community response to various noise exposure levels. The public reaction to different noise levels has been estimated from extensive research on human responses to exposure of different levels of aircraft noise. Noise standards generally are expressed in terms of the DNL 24-hour averaging scale (CNEL in California) based on the A-weighted decibel. Utilizing these metrics and surveys, agencies have developed standards for assessing the compatibility of various land uses with the noise environment. There are no single event noise based noise/land use compatibility criteria that have been adopted by the Federal Government or the State of California.

This section presents information regarding noise and land use criteria useful in the evaluation of noise impacts. The Federal Aviation Administration has a long history of publishing noise/land use assessment criteria for airports. These laws and regulations provide the basis for local development of airport plans, analyses of airport impacts, and the enactment of compatibility policies. Other agencies including the EPA, the Department of Defense, the State of California, the City of Long Beach and most cities have developed noise/land use compatibility criteria. A summary of some of the more pertinent regulations and guidelines are presented in the following paragraphs.

Federal Aviation Administration

• **Airport and Airway improvement Act of 1982, as amended (Public Laws 91-258 and 94-353).**

This act establishes the Federal requirements for funding of airport planning under the Planning Grant Program (PGP), airport development under Airport Development Aid Program (ADAP) and the Airport Improvement Program (AIP). An Airport and Airway Trust Fund is created to pay for these programs and operations of the Federal Aviation system. The general types of projects eligible for Federal funding are indicated. Additionally, the Act directs the preparation of a National Airport System Plan (NASP) that lists the location of airports in the national system of airports and the recommended development of each.

Among the conditions for Federal funding are two requirements involving airport/land use compatibility. As a condition to the receipt of AIP funds, the airport sponsor (owner) must, among other things, give assurances regarding land uses in the airport environs that:

"The aerial approaches to the airport will be adequately cleared and protected by removing, lowering, relocating, marking, lighting or otherwise mitigating existing airport hazards and by preventing the establishment or creation of future airport hazards";

and that: "Appropriate action, including the adoption of zoning laws, has been or will be taken to the extent reasonable, to restrict the use of land adjacent to or in the immediate vicinity of the airport to activities and purposes compatible with normal airport operations, including landing and takeoff of aircraft."

• Federal Aviation Regulations, Part 36, "Noise Standards: Aircraft Type and Airworthiness Certification".

Originally adopted in 1960, FAR Part 36 prescribes noise standards for issuance of new aircraft type certificates. Part 36 prescribes limiting noise levels for certification of new types of propeller-driven, small airplanes as well as for transport category, large airplanes. Subsequent amendments extended the standards to certain newly produced aircraft of older type designs. Other amendments have at various times extended the required compliance dates. Aircraft may be certificated as Stage 1, Stage 2, or Stage 3 aircraft based on their noise level, weight, number of engines and in some cases number of passengers. Stage 1 aircraft are no longer permitted to operate in the U.S. Stage 2 aircraft are being phased out of the U.S. fleet as discussed in a later paragraph on the Airport Noise and Capacity Act of 1990. Although aircraft meeting Part 36 standards are noticeably quieter than many of the older aircraft, the regulations make no determination that such aircraft are acceptably quiet for operation at any given airport.

• U.S. Department of Transportation/FAA Aviation Noise Abatement Policy.

This policy, adopted in 1976, sets forth the noise abatement authorities and responsibilities of the Federal Government, airport proprietors, State and Local governments, the air carriers, air travelers and shippers, and airport area residents and prospective residents. The basic thrust of the policy is that the FAA's role is primarily one of regulating noise at its source (the aircraft) plus supporting local efforts to develop airport noise abatement plans. The FAA will give high priority in the allocation of ADAP (now AIP) funds to projects designed to ensure compatible use of land near airports, but it is the role of State and Local governments and airport proprietors to undertake the land use and operational actions necessary to promote compatibility.

• Aviation Safety and Noise Abatement Act of 1979.

Further weight was given to the FAA's supporting role in noise compatibility planning by congressional adoption of this legislation. Among the stated purposes of this act is "To provide assistance to airport operators to prepare and carry out noise compatibility programs". The law establishes funding for noise compatibility planning and sets the requirements by which airport operators can apply for funding. This is also the law by which Congress mandated that FAA develop an airport community noise metric that would be used by all federal agencies assessing or regulating aircraft noise. The result was DNL. Because California already had a well-established airport community noise metric in CNEL, and because CNEL and DNL are so similar, FAA expressly allows CNEL to be used in lieu of DNL in noise assessments performed for California airports. The law does not require any airport to develop a noise compatibility program.

• Federal Aviation Regulations, Part 150, "Airport Noise Compatibility Planning".

As a means of implementing the Aviation Safety and Noise Abatement Act, the FAA adopted Regulations on Airport Noise Compatibility Planning Programs. These regulations are spelled out in FAR Part 150. As part of the FAR Part 150 Noise Control program, the FAA published noise and land use compatibility charts to be used for land use planning with respect to aircraft noise. An expanded version of this chart appears in Aviation Circular 150/5020-1 (dated August 5, 1983) and is reproduced in Exhibit 1-9.

These guidelines represent recommendations to local authorities for determining acceptability and permissibility of land uses. The guidelines recommend a maximum amount of noise exposure (in terms of the cumulative noise metric DNL) that might be considered acceptable or compatible to people in living and working areas. These noise levels are derived from case histories involving aircraft noise problems at civilian and military airports and the resultant community response. Note that residential land use is deemed acceptable for noise exposures up to 65 dB DNL. Recreational areas are also considered acceptable for noise levels above 65 dB DNL (with certain exceptions for amphitheaters). However the FAA guidelines indicate that ultimately "the responsibility for determining the acceptability and permissible land uses remains with the local authorities." The FAA permits substitution of CNEL for DNL in California.

• Federal Aviation Order 5050.4 and Directive 1050.1E for Environmental Analysis of Aircraft Noise Around Airports.

The FAA has developed guidelines (Order 5050.4D) for the environmental analysis of airports. Federal requirements now dictate that increases in noise levels in noise sensitive land uses of over 1.5 dB DNL within the 65 dB DNL contour are considered significant (1050.1E Directive 6.08.04):

> ***"14.3 SIGNIFICANT IMPACT THRESHOLDS.*** *A significant noise impact would occur if analysis shows that the proposed action will cause noise sensitive areas to experience an increase in noise of DNL 1.5 dB or more at or above DNL 65 dB noise exposure when compared to the no action alternative for the same timeframe. For example, an increase from 63.5 dB to 65 dB is considered a significant impact."*

The directive goes on further to discuss potential impacts withithe 60 to 65 DNL contour:

> ***"14.4c****. In accordance with the 1992 FICON (Federal Interagency Committee on Noise) recommendations, examination of noise levels between DNL 65 and 60 dB should be done if determined to be appropriate after application of the FICON screening procedure (FICON p.3-5). If screening shows that noise sensitive areas at or above DNL 65 dB will have an increase of DNL 1.5 dB or more, further analysis should be conducted to identify noise-sensitive areas between DNL 60-65 dB having an increase of DNL 3 dB or more due to the proposed action. The potential for mitigating noise in those areas should be considered, including consideration of the same range of mitigation options available at DNL 65 dB and higher and eligibility for federal funding. This is not to be interpreted as a commitment to fund or otherwise implement mitigation measures in any particular area. (FICON p. 3-7)."*

• Airport Noise and Capacity Act of 1990

The Airport Noise and Capacity Act of 1990 (PL 101-508, 104 Stat. 1388), also known as ANCA or the Noise Act, established two broad directives to the FAA: (1) Establish a method to review aircraft noise, airport use or airport access restrictions, imposed by airport proprietors; and (2) institute a program to phase-out Stage 2 aircraft over 75,000 pounds by December 31, 1999. Stage 2 aircraft are older, noisier aircraft (B-737-200, B-727 and DC-9); Stage 3 aircraft are newer, quieter aircraft (B-737-300, B-757, MD80/90). To implement ANCA, FAA amended Part 91 and issued a new Part 161 of the Federal Aviation Regulations. Part 91 addresses the phase-out of large Stage 2 aircraft and the phase-in of Stage 3 aircraft. Part 161 establishes a stringent review and approval process for implementing use or access restrictions by airport proprietors.

Part 91 generally states that all Stage 2 aircraft, over 75,000 pounds, will be out of the domestic fleet by December 31, 1999. The State of Hawaii and Alaska are not affected by this regulation. The agency may, for individual cases, grant waivers through 2002. But for the most part, only Stage 3 aircraft greater than 75,000 pounds are expected to be in the domestic fleet after that date. The domestic airline fleet in the mainland became all Stage 3 in the year 2000.

Land Use	Yearly day-night average sound level (Ldn) in decibels					
	Below 65	65-70	70-75	75-80	80-85	Over 85
RESIDENTIAL						
Residential, other than mobile homes and transient lodging	Y	N(1)	N(1)	N	N	N
Mobile home parks	Y	N	N	N	N	N
Transient lodgings	Y	N(1)	N(1)	N(1)	N	N
PUBLIC USE						
Schools	Y	N(1)	N(1)	N	N	N
Hospitals and nursing homes	Y	25	30	N	N	N
Churches, auditoriums, and concert halls	Y	25	30	N	N	N
Government services	Y	Y	25	30	N	N
Transportation	Y	Y	Y(2)	Y(3)	Y(4)	Y(4)
Parking	Y	Y	Y(2)	Y(3)	Y(4)	N
COMMERCIAL USE						
Offices, business and professional	Y	Y	25	30	N	N
Wholesale and retail--building materials, hardware and farm equipment	Y	Y	Y(2)	Y(3)	Y(4)	N
Retail trade--general	Y	Y	25	30	N	N
Utilities	Y	Y	Y(2)	Y(3)	Y(4)	N
Communication	Y	Y	25	30	N	N
MANUFACTURING AND PRODUCTION						
Manufacturing, general	Y	Y	Y(2)	Y(3)	Y(4)	N
Photographic and optical	Y	Y	25	30	N	N
Agriculture (except livestock) and forestry	Y	Y(6)	Y(7)	Y(8)	Y(8)	Y(8)
Livestock farming and breeding	Y	Y(6)	Y(7)	N	N	N
Mining and fishing, resource production and extraction	Y	Y	Y	Y	Y	Y
RECREATIONAL						
Outdoor sports arenas and spectator sports	Y	Y(5)	Y(5)	N	N	N
Outdoor music shells, amphitheaters	Y	N	N	N	N	N
Nature exhibits and zoos	Y	Y	N	N	N	N
Amusements, parks, resorts, and camps	Y	Y	Y	N	N	N
Golf courses, riding stables and water recreation	Y	Y	25	30	N	N

Numbers in parenthesis refer to notes.

*The designations contained in this table do not constitute a Federal determination that any use of land covered by the program is acceptable or unacceptable under Federal, State, or local law. The responsibility for determining the acceptable and permissible land uses and the relationship between specific properties and specific noise contours rests with the local authorities. FAA determinations under Part 150 are not intended to substitute federally determined land uses for those determined to be appropriate by local authorities in response to locally determined needs and values in achieving noise compatible land uses.

Key to Table 1

SLUCM Standard Land Use Coding Manual.
Y (YES) Land Use and related structures compatible without restrictions.
N (No) Land Use and related structures are not compatible and should be prohibited.
NLR Noise Level Reduction (outdoor to indoor) to be achieved through incorporation of noise attenuation into the design and construction of the structure.
25, 30, or 35 Land use and related structures generally compatible; measures to achieve NLR of 25, 30 or 35 dB must be incorporated into design and construction of structure.

Notes for Table 1

(1) Where the community determines that residential or school uses must be allowed, measures to achieve outdoor to indoor Noise Level Reduction (NLR) of at least 25 dB and 30 dB should be incorporated into building codes and be considered in individual approvals. Normal residential construction can be expected to provide a NLR of 20 dB, thus, the reduction requirements are often stated as 5, 10 or 15 dB over standard construction and normally assume mechanical ventilation and closed windows year round. However, the use of NLR criteria will not eliminate outdoor noise problems.

(2) Measures to achieve NLR of 25 dB must be incorporated into the design and construction of portions of these buildings where the public is received, office areas, noise sensitive areas or where the normal noise level is low.

(3) Measures to achieve NLR of 30 dB must be incorporated into the design and construction of portions of these buildings where the public is received, office areas, noise sensitive areas or where the normal noise level is low.

(4) Measures to achieve NLR of 35 dB must be incorporated into the design and construction of portions of these buildings where the public is received, office areas, noise sensitive areas or where the normal noise level is low.

(5) Land use compatible provided special sound reinforcement systems are installed.

(6) Residential buildings require an NLR of 25.

(7) Residential buildings require an NLR of 30.

(8) Residential buildings not permitted.

Source: FAR Part 150

Exhibit 1-9

FAA Part 150 Noise Compatibility

Long Beach Airport Terminal Improvement EIR

Part 161 sets out the requirements and procedures for implementing new airport use and access restrictions by airport proprietors. Proprietors must use the DNL metric to measure noise effects and the Part 150 land use guideline table, including 65 dB DNL, as the threshold contour to determine compatibility, unless there is a locally adopted more stringent standard. CNEL would be an acceptable surrogate for DNL.

The regulation identifies three types of use restrictions and treats each one differently: (1) negotiated restrictions, (2) Stage 2 aircraft restrictions and (3) Stage 3 aircraft restrictions. Generally speaking, any use restriction affecting the number or times of aircraft operations will be considered an access restriction. Even though the Part 91 phase-out does not apply to aircraft under 75,000 pounds, FAA has determined that Part 161 limitations on proprietors' authority applies as well to the smaller aircraft.

Negotiated restrictions are more favorable from the FAA's standpoint, but still require unwieldy procedures for approval and implementation. In order to be effective the agreements normally must be agreed to by all airlines using the airport.

Stage 2 restrictions are more difficult, because one of the major reasons for ANCA was to discourage local restrictions more stringent than the 1999 phase-out already contained in ANCA. To comply with the regulation and institute a new Stage 2 restriction, the proprietor must generally do two things. It must prepare a cost/benefit analysis of the proposed restriction and give proper notice. The cost/benefit analysis is extensive and entails considerable evaluation. Stage 2 restrictions do not require approval by the FAA, but it can be challenged by the FAA if not deemed to be "reasonable" based on the airport proprietors FAA Grant "Sponsors Assurances."

Stage 3 restrictions are even more difficult to implement. A Stage 3 restriction involves considerable additional analysis, justification, evaluation and financial discussion. In addition, a Stage 3 restriction must result in a decrease in noise exposure of the 65 dB DNL to noise sensitive land uses (residences, schools, churches, parks). The regulation requires both public notice and FAA approval.

ANCA applies to all new local noise restrictions and amendments to existing restrictions proposed after October 1990. The noise regulations and access restrictions established by the City of Long Beach at Long Beach Airport were implemented prior to the 1990 deadline in ANCA and are 'Grandfathered' under the terms of the act.

Environmental Protection Agency Noise Assessment Guidelines

• Environmental Protection Agency, "Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety".

In March 1974, in response to a federal statutory mandate, the EPA published this document[1] (EPA 550/9-74-004) describing 55 dB DNL as the requisite level with an adequate margin of safety for areas with outdoor uses, including residences and recreational areas. This document does not constitute EPA regulations or standards. Rather, it is intended to "provide State and Local governments as well as the Federal Government and the private sector with an informational point of departure for the purpose of decision-making". Note that these levels were developed for suburban type uses. In some urban settings, the noise levels will be significantly above this level, while in some wilderness settings, the noise levels will be well below this level. The EPA "levels document" does not constitute a standard, specification or regulation, but identifies safe levels of environmental noise exposure without consideration for achieving these levels or other potentially relevant considerations. These EPA guidelines have not been adopted or recommended for use by the FAA, the State of California, or the City of Los Angeles.

Federal Interagency Committee on Noise (FICON) Report of 1992 [8]

• The use of the CNEL or DNL metric and the 65 dB CNEL criteria has been reviewed by various interest groups concerning its usefulness in assessing aircraft noise impacts. At the direction of the EPA and the FAA, the Federal Interagency Committee On Noise (FICON) was formed to review specific elements of the assessment of airport noise impacts and to make recommendations regarding potential improvements. FICON includes representatives from the Departments of Transportation, Defense, Justice, Veterans Affairs, Housing and Urban Development, the Environmental Protection Agency, and the Council on Environmental Quality.

FICON was formed to review Federal policies used to assess airport noise impacts and on the manner in which noise impacts are determined. This included whether aircraft noise impacts are fundamentally different from other transportation noise impacts; the manner in which noise impacts are described; and the extent to which impacts outside of DNL 65 should be reviewed in federal environmental impact statements.

The committee determined that there are no new descriptors or metrics of sufficient scientific standing to substitute for DNL. The DNL noise exposure metric and the dose-response relationships used to determine noise impact were determined to be proper for assessing noise from civil and military aviation in the general vicinity of airports. The report supported agency discretion in the use of supplemental noise analysis. The report recommended improvement in public understanding of the DNL, supplemental methodologies and aircraft noise impacts.

The report endorsed and expanded traditional FAA environmental screening criteria for potential airport noise impacts. FICON recommended that if screening analysis determines noise-sensitive areas at or above DNL 65 dB show an increase of DNL 1.5 dB or more, then further analysis should be conducted of noise sensitive areas between DNL 60-65 dB having an increase of DNL 3 dB or more. The most recent FAA environmental guidelines, Order1050.1E, incorporates these FICON recommendations.

State of California

• The Aeronautics Division of the California State Department of Transportation (Caltrans) enforces the California Airport Noise Regulations. These regulations establish 65 dB CNEL as a noise impact boundary within which there shall be no incompatible land uses. This requirement is based, in part, upon the determination in the Caltrans regulations that 65 dB CNEL is the level of noise which should be acceptable to “...a reasonable man residing in the vicinity of an airport.” Airports are responsible for achieving compliance with these regulations. Compliance can be achieved through noise abatement alternatives, land acquisition, land use conversion, land use restrictions, or sound insulation of structures. Airports not in compliance can operate under variance procedures established within the regulations.

• Californian Noise Insulation Standards[12] apply to all multi-family dwellings built in the State. Single-family residences are exempt from these regulations. With respect to community noise sources, the regulations require that all multi-family dwellings with exterior noise exposures greater that 60 dB CNEL must be sound insulated such that the interior noise level will not exceed 45 dB CNEL. These requirements apply to all roadway, rail, and airport noise sources.

• The State of California requires that all municipal General Plans contain a Noise Element [13]. The requirements for the Noise element of the General Plan include describing the noise environment quantitatively using a cumulative noise metric such as CNEL or DNL, establishing noise/land use compatibility criteria, and establishing programs for achieving and/or maintaining compatibility. Noise elements shall address all major noise sources in the community including mobile and stationary sources.

• Airport Land Use Commissions were created by State Law[14] for the purpose of establishing a regional level of land use compatibility between airports and their surrounding environs. The Los Angeles County Airport Land Use Commission has adopted an Airport Environs Land Use Plan (AELUP) for Los Angeles County airports including Long Beach Airport. The AELUP establishes noise/land use acceptability criteria for sensitive land uses at 65 dB CNEL for outdoor areas and 45 dB CNEL for indoor areas of residential land uses.

City of Long Beach

• The General Plan Noise Element of the City of Long Beach was developed in 1974 and has not been updated since. The noise element does not have specific citywide noise standards, but it does utilize and reference the State of California Airport Noise Regulations and the 65 CNEL boundary as the noise impact boundary for the airport.

• The City of Long Beach has adopted an airport noise control ordinance. There are 2 major components to the ordinance. The first established single event noise limits for aircraft operating into and out of the airport. The second part of the ordinance establishes a noise budget for the various categories of aircraft at the airport. These 2 sections are described as follows:

Ordinance Section 16.43.040: Maximum SENEL Limits:

A. Subject to the authority of the Airport Manager to adjust permissible single event noise limits for categories of airport users in order to reduce such group's cumulative noise levels, all non-governmental operations at the airport shall meet the SENEL limits shown in Table 1-2:

Table 1-2: SENEL Limits in Long Beach Noise Ordinance

Runway	7am-10pm (Dep/Arrival)	10pm-11pm & 6am-7am (Dep/Arrival)	11pm-6am (Dep/Arrival)	Monitoring Station No.** (Dep/Arrival)
30	102.5/101.5	90/90	79/79	9/10
12	102.5/101.5	90/90	79/79	10/9
25R	92/88	*	*	6/1
25L	95/93	*	*	5/2
7R	95/92	*	*	2/5
7L	88/92	*	*	1/6
* Except in case of emergency or air traffic direction, all aircraft operations between the hours of 10pm and 7am are limited to runways 30 and 12.				

B. Violations occurring during the period between 10pm and 11pm that are the result of unanticipated delays beyond the reasonable control of the aircraft owner/operator shall be waived upon the presentation of evidence satisfactory to the airport manager that delayed arrival or departure resulted from such circumstances. Delays caused by mechanical failure (but not by routine maintenance), by weather conditions or by air traffic control conditions will be considered beyond the owner/operator's control.

C. The SENEL limits for the period from 6am-7am and from 10pm-11pm shall be subject to revision at the end of the fourth calendar quarter following the implementation of this Chapter. If, for the period covered by the four calendar quarters following the implementation of this Chapter, cumulative aircraft noise has exceeded the level allowed by Section 16.43.050A, these limits shall be reduced to 85 SENEL. The SENEL for the period from 6am-7am and from 10pm-11pm shall, however, revert to 90 SENEL if, for any subsequent four quarters, cumulative aircraft noise has not exceeded the level allowed by Section 16.43.050.

The paragraphs above describe the single event noise limits that all non-governmental aircraft must meet in order to operate at LGB. The noise office at the airport monitors these levels for each flight with a state of the art noise monitoring system. The noise monitor locations are shown in Exhibit 1-10.

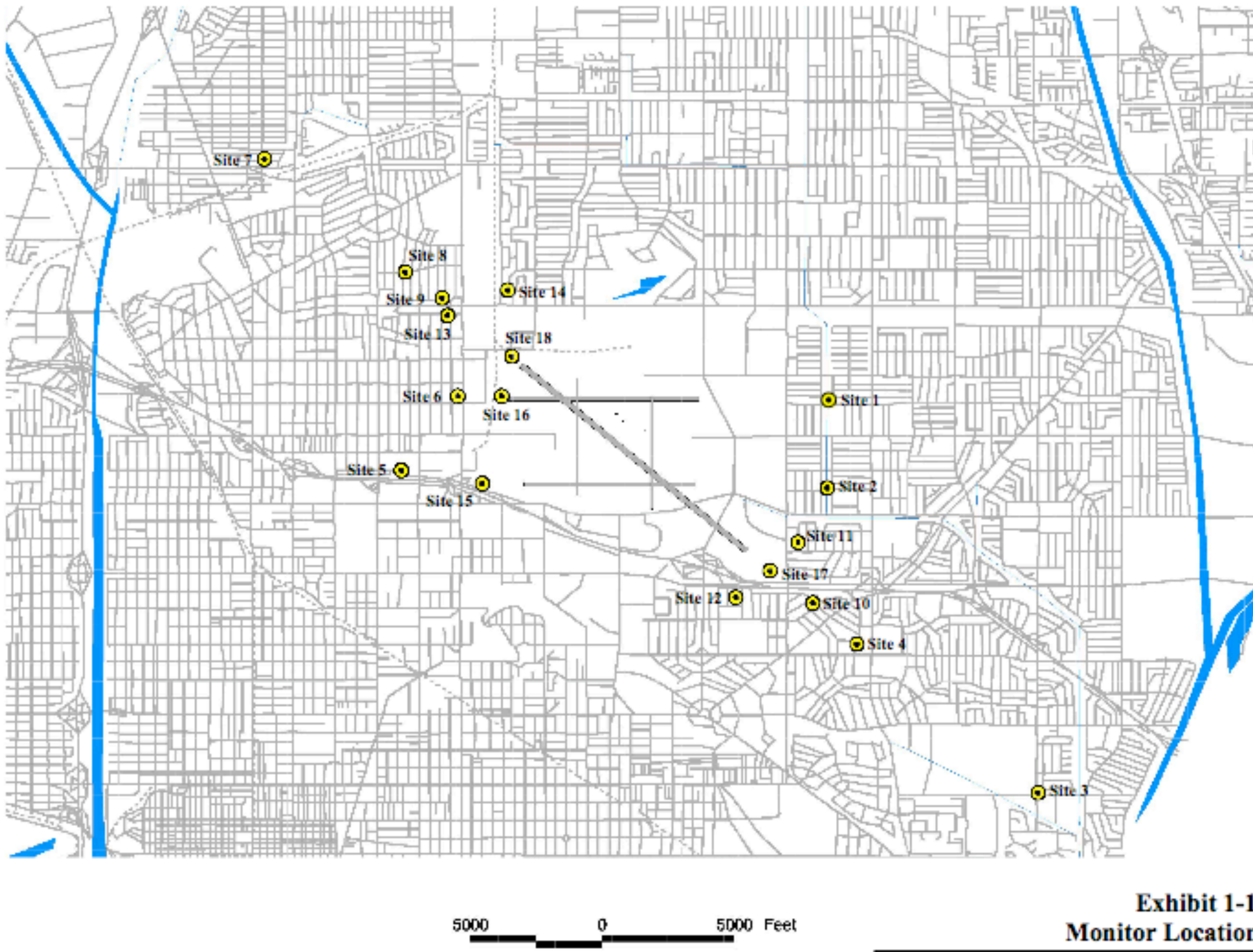


Exhibit 1-10
Monitor Locations

Long Beach Airport Terminal Improvement EIR

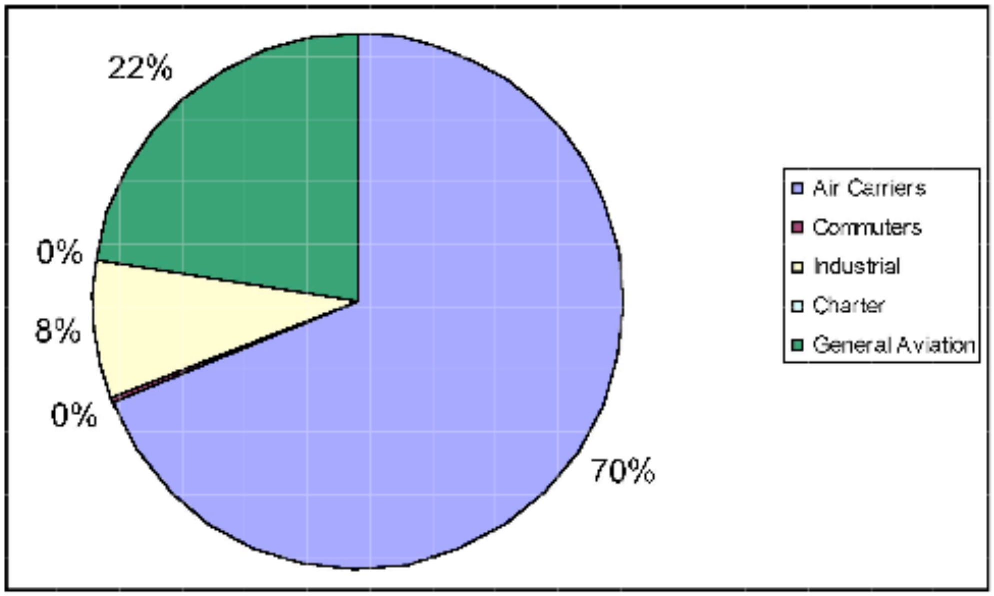


Exhibit 1-11
Budget User Group Allocation (RMT 9)

Ordinance Section 16.43.050: Noise Budget:
The Noise Ordinance includes Section 16.43.050, Cumulative Noise Limits and Noise Budgets, and Section 16.43.060, Compliance With Noise Budgets. The Technical Appendix to Chapter 16.43 of the Long Beach Municipal Code includes the Noise Contribution Budgets for 5 groups of operators including Air Carrier, Commuters, Industrial, Charter and General Aviation users. Exhibit 1-11 shows a pie chart depicting the aircraft operator categories and the percent of the budget allocated to that category. The method of measuring compliance with the budget limits is complex. For purposes of this report the following paragraphs describe how the budget is calculated for the air carrier and cargo category of the budget.

The noise budget is enforced based on the measured single event noise level as measured at noise monitors 9 and 10. The conversion of the measured SEL at RMT 9 and RMT 10 is done according to the budget definitions and as prescribed in the City's Noise Compatibility Ordinance (LBMC 16.43).

The first step in analyzing the data is to convert the noise measurements made at RMT 9 and RMT 10 to the noise level at the nearest residences to Runway 12/30. For RMT 9 the noise level is increased by 1.1 dB and at RMT 10 the noise level is increased by 0.9 dB to account for the fact that the nearest homes are closer to the runway than the actual monitoring stations.

The next step is to convert the noise level at the nearest home to an equivalent number of daytime flights of the 'standard' aircraft that is built into the budget. These equivalent number of daytime flights are termed "budget units." The 'standard' aircraft noise level is the SEL that 100 daytime flights would have to have to produce a CNEL of 65 dB at the nearest residence.

The equation for CNEL as a function of SEL and number of daytime flights is as follows:

$$CNEL = SEL + 10Log_{10}N_{eq} - 49.4$$

The above equation can be solved for a value of 65 CNEL and 100 daytime flights and the result is that the 'standard' aircraft SEL is 94.4 dB. The task of converting the actual SEL to an equivalent number of budget units is done using the following equation:

$$N = \frac{10^{SEL/10}}{10^{94.4/10}}$$

The N computed in the above equation is the number of equivalent noise budget units that are contributed to the budget for a daytime flight. If the flight occurred between the hours of 7 pm and 10 pm, the result is multiplied by a factor of 3. If the flight occurred between the hours of 10 pm and 7 am the result is multiplied by a factor 10. Note that for purposes of this computation, the evening penalty begins at 7:00:00 pm and ends at 9:59:59 pm and the night penalty begins at 10:00:00 pm and ends at 6:59:59 pm. There are no exceptions to the evening and night penalties. For example an aircraft may begin its takeoff roll prior to 10 pm but produce a noise event at RMT 9 or 10 after 10 pm. In that case the after 10 pm penalty is applied.

Table 1-3 lists the aircraft operator categories included in the budget and the budget allocated to those categories.

Table 1-3: Budget Categories and Allocated Budget

Airport User Category	Residences Nearest to Station 9	Residences Nearest to Station 10
Air Carriers	70.7	84.6
Commuters	0.4	3.6
Industrial	8.5	6.6
Charter	0.14	0.09
General Aviation	23	26.0
Total:	102.74	120.89

Budget number represents number of operations, weighted by time of day and noise level.

An interesting characteristic of the budget is that the number of equivalent flights permitted do not add up to 100 flights. That is because the budget was set to the number of equivalent operations that were flown during the baseline period from November 1989 through October 1990, except that the industrial budget was increased to reflect the projected flights by new aircraft not in regular operation during the baseline period.

During the baseline period there were 102.74 equivalent flights at residences nearest Station 9 and 120.89 equivalent flights at residences nearest Station 10 (including industrial budget increases as requested by industrial users at the time the budget was adopted). The 102.74 and 120.89 equivalent flights can be used to compute the CNEL at the residences during the baseline period using the previously calculated 94.4 dB SENEL noise level for an equivalent flight. The CNEL computed for the residences near Stations 9 and 10 are 65.1 and 65.8 dB respectively. These are the CNEL values (less military and non-Runway 30/12 noise) that the budget permits at the nearest residences.

The terms of the LGB noise budget also includes a provision that the air carrier/cargo category is permitted a minimum of 41 departures per day and commuter operators are permitted a minimum of 25 departures per day. The budget allows the City to allocate additional flights if the air carriers or commuters operate below the allocated budget. This will be discussed later in this report.

2.0 METHODOLOGY

The methods used here for describing existing noise and forecasting the potential future with optimized flight levels noise environment rely heavily on computer noise modeling. The noise environment is commonly depicted in terms of lines of equal noise levels, or noise contours. These noise contours are supplemented here with specific noise data for selected points on the ground. The computer noise models used here are described in the following below.

2.1 COMPUTER MODELING

Noise contour modeling is a very key element of this noise study. Generating accurate noise contours is largely dependent on the use of a reliable, validated, and updated noise model. It is imperative that these contours be accurate for the meaningful analysis of airport and roadway noise impacts. The computer model can then be used to predict the changes to the noise environment as a result of any of the alternatives under consideration. The following noise computer model was used in this study:

• The FAA's Integrated Noise Model (INM) Version 6.1 was used to model aircraft operations at Long Beach Airport. The INM has an extensive database of civilian and military aircraft noise characteristics and this most recent version of INM incorporates advanced plotting features. Noise contour files from the INM were loaded into the Arcview™ Geographic Information System (GIS) software for plotting and land use analysis. All of the CNEL contours presented in the report were developed by AAAI, Inc for the City of Long Beach. Single event noise contours were developed by Mestre Greve Associates.

Airport noise contours were generated in this study using the INM Version 6.1.[15] The original INM was released in 1977. The latest version, INM Version 6.1, was released for use in September 2001 and is the state-of-the-art in airport noise modeling. The INM is a large computer program developed to plot noise contours for airports. The program is provided with standard aircraft noise and performance data for over 100 civilian aircraft types that can be tailored to the characteristics of the airport in question, as well as a database of military aircraft types. Version 6.1 includes an updated database that includes some newer aircraft, the ability to include runups in the computations, the ability to include topography in the computations, and the provision to vary aircraft altitude profiles in an automated fashion.

One of the most important factors in generating accurate noise contours is the collection of accurate operational data. The INM program requires the input of the physical and operational characteristics of the airport. Physical characteristics include runway coordinates, airport altitude, and temperature and optionally, topographical data. Operational characteristics include various types of aircraft data. This includes not only the aircraft types and flight tracks, but also departure procedures, arrival procedures and stage lengths (flight distance) that are specific to the operations at the airport. Aircraft data needed to generate noise contours include:

- Number of aircraft operations by type
- Types of aircraft
- Day/Evening/Night time distribution by type
- Flight tracks
- Flight track utilization by type
- Flight profiles
- Typical operational procedures
- Average Meteorological Conditions

3.0 NOISE

3.1 EXISTING NOISE ENVIRONMENT

Long Beach Airport (LGB) serves both general aviation and scheduled commercial passenger airline and cargo operations. Boeing and Gulfstream are industrial users that build and/or modify aircraft for civilian and military use. The use of LGB is heavily regulated as a result of the environmental sensitivity of the local area, and because of airport related litigation.

LGB prepares quarterly and annual noise reports as part of its Noise Management Program. The airport operates a noise and aircraft track monitoring systems known as ANOMS. The data from this system are used to enforce the airport single event noise limits and are used to calculate the status of the airport noise budget. The noise levels of all commercial aircraft operations and many general aviation operations are recorded at 18 permanent noise monitoring stations around the airport. Both CNEL and SENEL are monitored and calculated for each day and each aircraft. A detailed report is compiled every three months summarizing this information, and each year an annual CNEL contour is computer modeled and included in the quarterly report. Noise complaint data is also meticulously recorded and analyzed.

3.1.1 Exisiting LGB Operations and Fleet Mix Data

Existing 2004 aircraft operations at LGB totaled 339,258 of which some 27,485 are jet air carrier and cargo operations and 10,950 are general aviation jets. There were no commuter operations in 2004. General aviation propeller aircraft constituted 298,214 operations, and were clearly the dominate in terms of number of operations. However, the air carrier and cargo jets represent the most dominate source of community noise. The type and number of air carrier aircraft using LGB during 2004 are summarized below in Table 3-1.

Table 3-1
Year 2004 Average Daily and Annual Operations

AIRLINE/AIRCRAFT		Average Daily 2004	Annual Operations
Air Carrier:			
American	B757	9.2	3,358
Airborne	B767	1.4	511
American	MD80	3.5	1,259
Alaska	MD80	0.3	91
Fedex	A330/A31	1.4	511
Fedex	B727/B727S	1.3	456
JetBlue	A320	42.9	15,640
American	B738	0.0	0
America West	CRJ7	0.3	91
America West	CRJ9	6.3	2,281
Alaska	B734	1.1	402
Alaska	B737	4.3	1,570
United Parcel	B757	0.0	0
United Parcel	B76S	2.5	913
United Parcel	DCH8	0.0	0
Subtotal Air Carriers:		**75.3**	**27,485**
Industrial:		0.0	0
Boeing	B717	0.4	146
Gulfstream	G5	1.8	639
Subtotal Industrial:		**2.2**	**785**
Charter:		0.0	0
Subtotal Charter:		**0.6**	**219**
Commuter:		0.0	0
Subtotal Commuter:		**0.0**	**0**
General Aviation:		0.0	0
BUSJETS		30.0	10,950
GA Prop*		817.0	298,214
Subtotal GA:		**847.0**	**309,164**
Military and Government:		0.0	0
MILITARY		1.8	657
GOV		2.6	967
Subtotal MIL & GOV:		**4.4**	**1,606**
TOTAL		**929.5**	**339,258**

Notes: One operation is one take-off or one landing. An aircraft arriving and LGB and then departing LGB generates 2 operations.
Air carrier subtotal does not add up due to rounding and multiple miscellaneous aircraft that are not included in the list but are included in the subtotal.

3.1.2 Existing LGB Runway and Flight Track Utilization

The flight tracks at LGB are well established to take advantage of the runway configuration and prevailing wind conditions. Runway 12/30 is the longest runway and is used for the larger aircraft including the air carrier and cargo operations. Runway 25R is used for these operations when Runway 12/30 is not available. About 97% of the jet air carrier and cargo operations occur on Runway 30, and winds result in use of Runway 12 less than 3% of the time. Exhibit 3-1 shows the flight tracks for Long Beach Airport used approximately 95% of the time by air carrier and other jet aircraft. Exhibit 3-2 shows the combined flight tracks for general aviation and air carrier aircraft.

3.1.3 Existing Long Beach CNEL Contours and Land Use Impacts

The CNEL contours used to depict existing noise exposure at LGB are derived from the Noise Abatement Quarterly report for the last quarter of 2004. They are depicted on Exhibit 3-3. The contours were developed by AAAI as part of their quarterly noise reports for the airport. The location of the ten permanent noise monitoring locations was shown on Exhibit 1-10.

The 2004 LGB 65 to 70 CNEL contour area includes 15 residential dwellings. The 70 CNEL contour includes no residential or other noise sensitive land uses. The 60 to 65 CNEL contour area includes 1,890 residences.

In addition to the CNEL contours, specific CNEL values are reported for each permanent noise measurement site. Table 3-2 displays CNEL values at each of the monitoring locations for Calendar Year 2004. The data include the noise level due to community noise (non-aircraft), aircraft noise, and the total noise at each site.

Table 3-2

YEAR 2004 Measured CNEL			
SITE	COMMUNITY	AIRCRAFT	TOTAL
1	57.7	52.4	58.8
2	57.9	51.5	58.8
3	64.6	58.8	65.7
4	61.9	61.6	64.8
5	71.5	53.4	71.6
6	64.1	61.3	66.0
7	62.0	58.4	63.5
8	59.7	61.9	64.0
9	60.8	63.8	65.5
10	68.6	64.8	70.1
11	63.1	56.5	64.0
12	67.3	54.9	67.5
13	61.0	64.4	66.0
14	60.5	60.4	63.5
15	67.1	60.6	68.0
16	86.9	66.5	86.9
17	70.5	66.1	71.8
18	63.6	69.0	70.0

3.1.4 Existing Long Beach Aircraft Single Event Noise

SENEL data for LGB varies by aircraft type. Even for a given aircraft type, airlines operate at different weights depending destination and load factor. SENEL contours are presented here for the reader to compare the difference in noise level that different aircraft make. Exhibit 3-4 shows the SENEL contours for arrivals to Runway 30 for a variety of the major aircraft that use this runway. Exhibit 3-5 shows the SENEL contours for departures on Runway 30 for these same aircraft. Note that 2 contours are shown for the A320, the aircraft used by JetBlue. One is for a short flight to Oakland and the other is for a long flight to New York. The difference in fuel required for these flights results in a heavier and noisier departure. Note that there are no SENEL contours for a single engine propeller aircraft operating on Runways 25 Right and Left because these aircraft did not produce an 85 SEL contour that left the airport boundary.

The SENEL contours shown in the above described exhibits are the 85 and 90 SENEL contours. The City Noise Ordinance limits SENEL values to a range between 79 and 102.5 dBA depending on runway, operation and time of day. There is no special significance to the 85 and 90 SENEL contours, other than it is approximately midway between 79 and 102.5 dBA. An SENEL of 90 dBA would produce a maximum noise level of approximately 80 dBA outdoors. The indoor maximum noise level for such a flight would be approximately 68 dBA for a home. The purpose of showing the 85 and 90 SENEL contours is to show a comparison of the noise level from different aircraft types.

Arrival Flight Tracks

Departure Flight Tracks

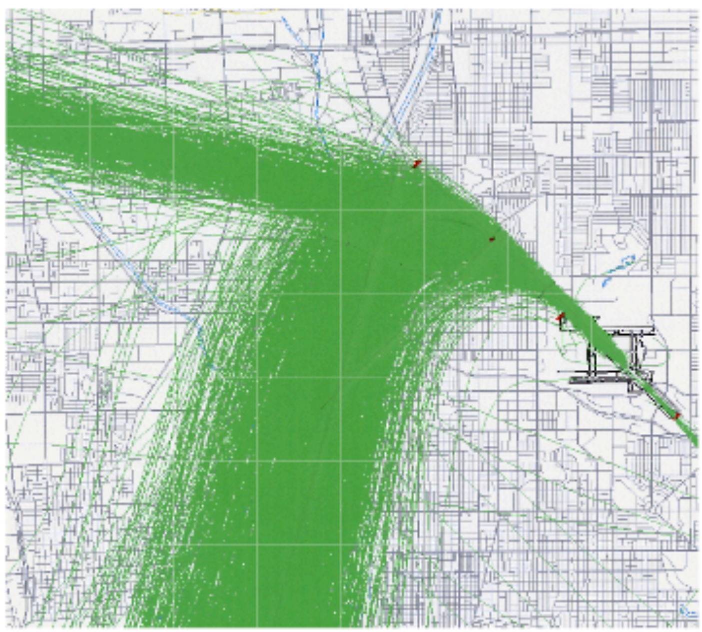
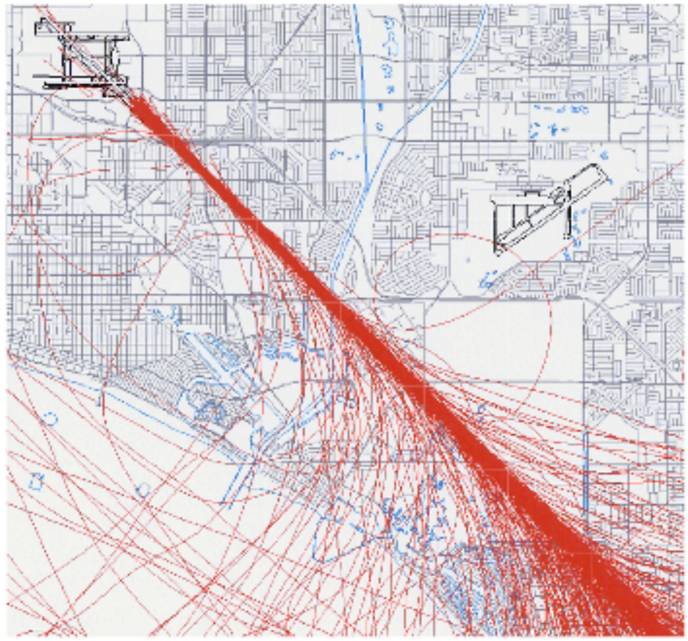


Exhibit 3-1
Air Carrier Radar Tracks
Long Beach Airport Terminal Improvement EIR

Arrival Flight Tracks



Departure Flight Tracks

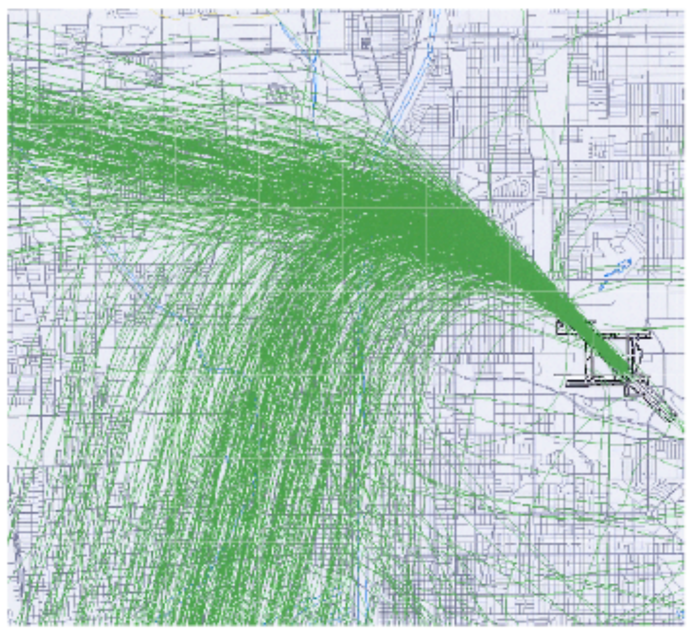
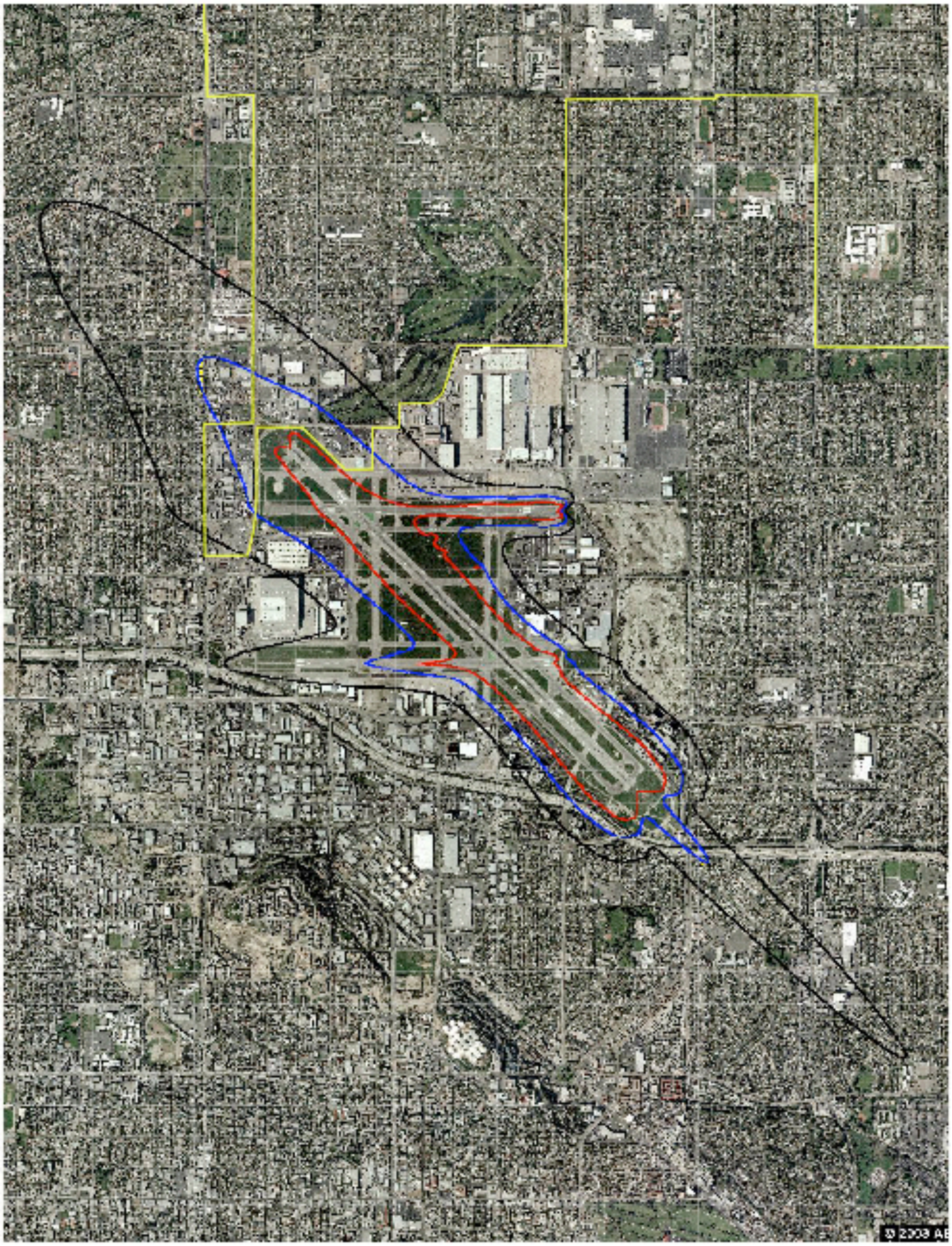


Exhibit 3-2
Business Jet Radar Tracks
Long Beach Airport Terminal Improvement EIR



60 CNEL
65 CNEL
70 CNEL
Municipal Boundary

Exhibit 3-3
Year 2004 CNEL Contours

Long Beach Airport Terminal Improvement EIR

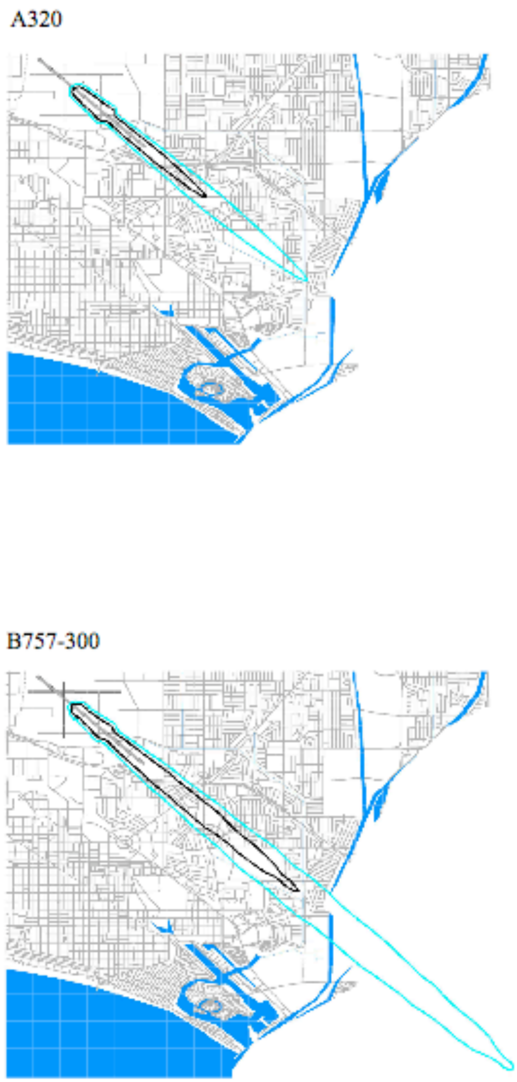


Exhibit 3-4a
A320, B727, B757-300 and B767-300 Arrival SEL Contour
Long Beach Airport Terminal Improvement EIR

Exhibit 3-4b
CL601, GIV, and MD83 Arrival SEL Contour
Long Beach Airport Terminal Improvement EIR

A320

A320 Stage 1

B727EM2

B757-300

85 SEL Contour

90 SEL Contour

Exhibit 3-5a

A320, A320 (Stage 1), B757 and B757-300 Departure SEL Contour

Long Beach Airport Terminal Improvement EIR

B767-300

CL601

GIV

MD83

85 SEL Contour

90 SEL Contour

Exhibit 3-5b

B767-300, CL601, GIV, and MD83 Departure SEL Contour

3.1.5 Exisiting Long Beach Aircraft Time of Day of Operations

Long Beach Airport operates under a nighttime restriction. That restriction includes air carrier operations before 7 am in the morning and after 10 pm at night. General aviation operations may occur during these night hours, provided such operations meet the strict night time noise limits that are in effect (see Table 1-2). Even with the night restriction on night operations of air carrier and cargo operations, weather, air traffic, and security delays result in air carrier and cargo operations during the night hours. During calendar year 2004 there were 28% evening and 2% night air carrier and cargo operations. A review of the year 2004 operations were used to generate the summary of night operations shown in Table 3-3. A total of 531 air carrier and cargo operations occurred during the night hours, however, more than half of these occurred within the first 10 minutes after 10 pm. During all of 2004 a total of 25 operations occurred after 11 pm. The fact that these operations occurred during the night hours is reflected in the noise budget computations that apply a severe penalty to night operations. Even those operations that occurred within minutes after 10pm are given the nighttime penalty for budget computation purposes.

Table 3-3
Breakdown of Night Air Carrier and Cargo Operations For 2004

Time Period	Operations
10:00 – 10:10	231
10:10 – 10:20	74
10:20 – 10:30	73
10:30 – 10:40	62
10:40 – 10:50	48
10:50 – 11:00	18
11:00 – Midnight	11
Midnight – 7:00	14

3.2 THRESHOLDS OF SIGNIFICANCE

Impacts to noise would be considered significant if the project would result in:

- Exceedance of the Noise Ordinances and the Noise Element of the General Plan.
- Exposure of persons to or generation of noise levels in excess of standards established in the general plan, noise ordinance and applicable standards of State and Federal Agencies.
- Exposure of persons to or generation of excessive ground born vibration or ground born noise levels.
- A substantial permanent increase in ambient noise levels in the project vicinity above existing levels existing without the project.
- A substantial temporary or periodic increase in ambient noise levels in the project vicinity above levels existing without the project,

Construction Noise

- Construction activities that exceed the Noise Ordinance.
- Construction activities lasting more than 10 days in a three month period that exceed existing ambient exterior noise levels by 5dBA Leq or more at a noise sensitive use.

Airport Noise

- Non compliance with the Noise Ordinances, regulations and Noise Element.

Construction noise impacts were assessed using the noise limits contained in the City of Long Beach Municipal Noise Ordinance (Section 8.80.010). The following are the limits specified in the ordinance:

8.80.202 Construction activity-Noise regulations.

The following regulations shall apply only to construction activities where a building or other related permit is required or was issued by the building official and shall not apply to any construction activities within the Long Beach harbor district as established pursuant to section 201 of the city charter.
A. Weekdays and federal holidays. No person shall operate or permit the operation of any tools or equipment used for construction, alteration, repair, remodeling, drilling, demolition or any other related building activity which produce loud or unusual noise which annoys or disturbs a reasonable person of normal sensitivity between the hours of seven p.m. and seven a.m. The following day on weekdays, except for emergency work authorized by the building official. For purposes of this section, a federal holiday shall be considered a weekday.

B. Saturdays. No person shall operate or permit the operation of any tools or equipment used for construction, alteration, repair, remodeling, drilling, demolition or any other related building activity which produce loud or unusual noise which annoys or disturbs a reasonable person of normal sensitivity between the hours of seven p.m. on Friday and nine a.m. on Saturday and after six p.m. on Saturday, except for emergency work authorized by the building official.

C. Sundays. No person shall operate or permit the operation of any tools or equipment used for construction, alteration, repair, remodeling, drilling, demolition or any other related building activity at any time on Sunday, except for emergency work authorized by the building official or except for work authorized by permit issued by the noise control officer.

D. Owner's/employer's responsibility. It is unlawful for the landowner, construction company owner, contractor, subcontractor or employer of persons working, laboring, building, or assisting in construction to permit construction activities in violation of provisions in this section.

E. Sunday work permits. Any person who wants to do construction work on a Sunday must apply for a work permit from the noise control officer. The noise control officer may issue a Sunday work permit if there is good cause shown; and in issuing such a permit, consideration will be given to the nature of the work and its proximity to residential areas. The permit may allow work on Sundays, only between nine a.m. and six p.m., and it shall designate the specific dates when it is allowed.

F. Enforcement. Notwithstanding the provisions of sections 8.80.370 and 8.80.380, this section may be enforced by a police officer.

Any person who violates any provision of this section is guilty of a misdemeanor and shall be fined in an amount not to exceed five hundred dollars, or be imprisoned for a period not to exceed one hundred eighty days, or by both such fine and imprisonment. Each day that a violation occurs shall constitute a separate offense and shall be punishable as such.

Whenever an employee is prosecuted for a violation of this noise control ordinance, the court shall, at the request of the employee, take appropriate action to make the landowner, construction company owner, contractor, subcontractor or employer a codefendant. (Ord. C-6488 § 1, 1988; Ord. C-6474 § 1, 1988).

The ordinance does not set specific noise limits for construction, but does limit the hours of construction. For purposes of this noise assessment the construction noise impacts will be assessed by comparing the construction noise levels with the noise levels permitted for other stationary noise sources in the city per Section 8.80.0160 of the Municipal Code. If the noise limits are exceeded at any residential location, the construction will be deemed significant. The noise limits are for exterior areas of a residential land use and are listed as follows:

	Noise Limit*				
Time Period	30 min	15 min	5 min	1 min	Maximum
7 am to 10 pm	50 dBA	55	60	65	70
10 pm to 7 am	45 dBA	50	55	60	65

* Noise limits in terms of noise level in dBA that may not be exceeded for specified number of minutes in any one hour and an absolute maximum.

The data in the above table indicate that during daytime hours the noise level may not exceed 50 dBA for more than 30 minutes in any one hour or 55 dBA for 15 minutes, 60 dBA for 5 minutes, 65 dBA for 1 minute, or 70 dBA for any period of time.

4.0 NOISE IMPACT ANALYSIS

This section analyzes noise for the passenger terminal project case and the no project cases. This project is a unique airport case because the number of air carrier, cargo and commuter operations at the airport are not affected by the terminal improvements. The airport noise budget is the controlling factor at the airport. The noise budget permits a minimum of 41 air carrier and cargo flights and 25 commuter flights daily. If the noise level and times of operations of these flights is such that the operations are below the budget, additional flights may be added (see Section 1.6). The noise budget results in operations that are so far below the airport capacity that, it is the budget that limits flight operations. For example, the FAA handbook on airport master planning [16] indicated that an airport with a single runway can handle as many as 55 operations per hour.

The following section addresses the issue of how many flights could be added beyond the 41 air carrier/cargo and 25 commuter flights if the fleet mix were quieter and there were fewer night operations.

4.1 NUMBER OF ADDITIONAL FLIGHTS REASONABLY ACCOMMODATED BY THE NOISE BUDGET

The purpose of this section is to present the results of an analysis to determine the realistic number of flights that could be accommodated under the Long Beach Airport Noise Budget if airlines used an optimized fleet and reduced the number of nighttime operations.

The assumptions used to develop this analysis are based on realistic assumptions about the fleet and time of operation as opposed to an idealized fleet with no night operations. In this context, realistic was defined according to the following rules:

- Each airline will continue to operate in its current market. For example, JetBlue will continue to operate primarily to the east coast (with high operating weights) with some flights to short destinations (with low operating weights). The important aspect of this assumption is that JetBlue will not become a short haul carrier, only serving Oakland, Las Vegas, Phoenix and the like.

- For each airline the fleet used at Long Beach will be the quietest aircraft that is currently in their fleet or the airline has firm orders to acquire that aircraft. In other words, airlines will only fly aircraft they currently own or are committed to purchase.

- The nighttime noise budget penalty for operations between 10 pm and 7 am is significant. In 2004, there were 531 night operations (. For purposes of this analysis it was assumed that airlines will reduce their night operations by 50% from 2004 levels. Due to weather, air traffic and security delays it is inconceivable that the airlines will achieve perfection and eliminate all night flights. The purpose of using an assumption of a 50% reduction in night operations is to determine the effect of this dramatic drop in night operations on the number of additional flights that can be accommodated.

- If the fleet mix and number of night operations are optimized such that more than 41 flights can be accommodated at Long Beach, the number of additional flights will depend on how many of the new flights occur during the evening and night hours. The more of the new flights that occur during the evening (7 pm to 10pm) and night hours (10 pm to 7am), then the fewer number of new flights that could be added. For purposes of this analysis, it was assumed that all new flights will be distributed throughout day according to the present distribution of flights, with reduced night operations. Specifically, based on the 2004 and 2003 budget year, 28% of any <u>new</u> flights will also occur during the evening hours (7 pm to 10 pm) and 1.7% will occur at night (10 pm to 7 am). Note that the 1.7% night operations reflects a 50% reduction from the actual level of night operations flown in budget year 2003 to reflect the previous assumption of a 50% improvement in night operation levels (Budget year 2003 showed 3.3% operations at night while budget year 2004 showed 2% operations at night. The budget year 2003 data were used here as worst case).

<u>Fleet Mix Assumption By Airline:</u> The following aircraft substitutions were made to optimize the fleet mix according the rules outlined above:

- American Airlines exchanges all of their MD80 operations for B737-800 aircraft.
- Federal Express exchanges all B727 aircraft for A300 aircraft.

- JetBlue exchanges one-third of their A320 aircraft for E190 aircraft (this assumption is high towards the E190 relative to the assumption that JetBlue continues to serve primarily east coast destinations, however, the E190 may be used on some domestic long haul flights and therefore was included here to ensure that a future scenario in which JetBlue moves many E190s into Long Beach is accounted for).

Resulting Additional Potential Flights: The number of potential additional flights beyond the base 41 flights is dependent on the type of aircraft that is added and whether that aircraft is flown heavy (long haul destination) or flown light (short haul destination). Table 4-1 shows the sensitivity of the number of additional flights to aircraft type and the time of the flight.

Table 4-1
Number of Potential Additional Flights* By Aircraft Type

	Base Aircraft**	Heavy A320	Average A320	B737-800
New flights 28% evening and 1.7% night	6.4	7.6	11.3	7.8

* Beyond the minimum 41 daily flights allowed in the budget
** Base aircraft in the budget is defined as an aircraft that produces a noise exposure of 65 CNEL for 100 daytime flights.

Table 4-1 shows that the number of potential new flights is sensitive to the aircraft type. For example, if the new flights are a heavy A320 (east coast destination) then there is the potential to have 7.6 additional flights, but there may be as many as 11.3 additional flights if the A320 is flown at a lighter weight, i.e., to a closer destination. For purposes of this report, average A320 will be used as the surrogate aircraft for estimating the number of additional flights that could possible be accommodated under the budget. This is due to the fact that it is the most frequently flown air carrier aircraft at the airport. Therefore, it is concluded that the largest number of additional flights that could be accommodated under the budget is approximately 11 flights per day. Note that in the allocation of any additional flights the City of Long Beach may have to allocate additional flights based on a commitment to operate specific aircraft types and destinations.

The 41 air carrier flights plus these additional air carrier flights plus the 25 commuter flights that are permitted by the budget constitute the maximum number of air carrier flights that can occur at the airport. And this is not dependent on the configuration of the terminal building. Note that the 25 commuter flights will fill the commuter budget and that there is not a foreseeable scenario in which additional commuter flights could be allocated under the budget.

4.2 CNEL CONTOURS AT FULL BUDGET UTILIZATION

Exhibit 4-1 shows CNEL contours for full budget utilization including 25 commuter flights and an additional 11 air carrier/cargo flights. The contours were generated by MGA using the 2004 data files prepared by AAAI, Inc.[17] and adjusting the operations for the additional commuter and air carrier flights and the change in fleet mix to accommodate the additional air carrier flights. These represent the CNEL contour for potential future with optimized flight levels operations.

A visual inspection of the contours indicates that the difference between the 2004 and the potential future with optimized flight levels contours sets is quite small. In fact, the contours for the case with the 25 commuters and additional 11 air carrier flights is slightly smaller than the 2004 contours to the north of the airport and slightly larger to the south. This difference pattern is due to the change out of the MD80 with the B737-800. The MD80 is noisier on departure and quieter on arrival than the B737-800. The 25 commuter flights, flown by regional jets, have virtually no effect on the contour size. Exhibit 4-2 shows the future noise contours that were developed for the 1985 Noise Compatibility Program [18].

When the existing noise contours and noise contours with the 25 additional commuter flights and additional air carrier flights are compared to the 1985 contours, the 1985 contours are larger.

4.3 CNEL LAND USE IMPACTS

Table 4-2 provides a comparison of the land uses located within the CNEL contours for the existing year 2004 conditions and the potential future with optimized flight levels year contours with the budget fully realized. The two schools that fall within the 60 CNEL contour for potential future with optimized flight levels operations are located south of the airport in the primary approach corridor. These include the Minnie Gant School on East Britton Drive and the Special Education Building located at the School Safety and Emergency Preparedness Offices of the Long Beach Unified School District located at 5250 Los Coyotes Diagonal.

Table 4-2
Comparison of Land Use Impacts, Number of Residences and Schools

	Year 2004 CNEL			Future With Additional Flights		
	>70	65- 70	60-65	>70	65- 70	60-65
Residences	0	15	1,890	0	11	1,791
Schools	0	0	0	0	0	2

4.4 CNEL RECEPTOR LOCATIONS

In addition to the CNEL contours, specific CNEL values are calculated for the 18 RMT locations around the airport. These estimates were made for existing conditions and for the potential future with optimized flight levels condition in which older noisier air carrier jets are replaced and the budget might allow for 11 additional air carrier flights, and the 25 additional commuter flights as well. All of these CNEL estimates were made using the INM.

Table 4-3
Comparison of Existing and Potential Future With Optimized Flight Levels CNEL

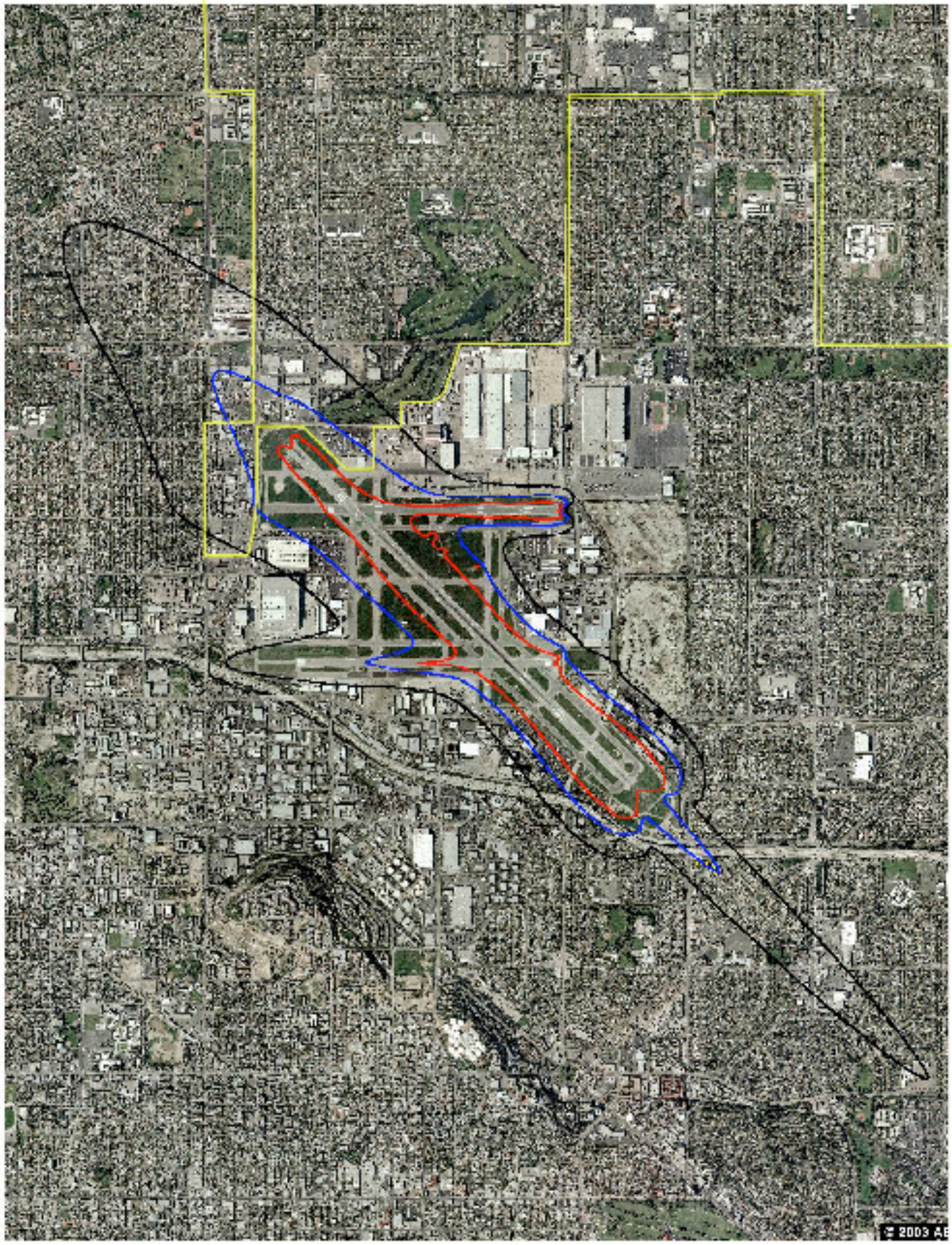
	CNEL		
RMT Location	Year 2004	Future*	Difference**
1	53.4	53.3	-0.1
2	53.2	53.0	-0.2
3	57.6	57.9	0.3
4	62.3	62.7	0.4
5	53.5	53.4	-0.1
6	61.9	61.7	-0.2
7	56.9	56.0	-0.9
8	62.2	61.5	-0.7
9	63.8	63.2	-0.6
10	64.3	64.7	0.4
11	60.3	59.9	-0.4
12	59.1	58.7	-0.4
13	64.4	63.9	-0.5
14	60.5	60.4	-0.1
15	60.2	60.2	0.0
16	65.8	65.5	-0.3
17	67.0	67.4	0.4
18	68.4	67.4	-1.0

* Future is the Year 2004 case with additional 25 commuter flights and 11 additional air carrier flights that replace older noisier air carrier jets.

Note that the INM computes the noise level to tenths of a decibel, but that the overall accuracy of the model is more in the range of plus or minus 1.5 to 2 dB.

4.5 LONG TERM USE OF PARCEL 'O'

Parcel O long term use will be as a tiedown and hangar area for general aviation aircraft. Activity in this area will primarily be the taxiing of aircraft to and from the tiedown area to the runways. The closest point of this tiedown area to the homes across Clark is about 1000 feet. For purposes of this analysis the noise associated with taxiing the noisiest of the single engine propeller aircraft was considered. This would be an aircraft like a Cessna 210 or Bonanza type aircraft (high performance single engine piston with variable pitch propeller). At a distance of 1000 feet, 2 noise levels were estimated. This first is the noise level associated with a power setting needed to initially move the aircraft from a stop (approximately 65% of full thrust) and the power setting needed to taxi the aircraft once moving (approximately 50% of full thrust). At the nearest homes across Clark the noise levels estimated are a maximum noise level 51 dBA (thrust necessary to overcome inertia) and taxiing noise level of 48 dBA. These operations would occur only for short periods of time and will meet the requirements of the Long Beach Noise Ordinance.



60 CNEL
65 CNEL
70 CNEL
Municipal Boundary

Exhibit 4-1
Year 2004 CNEL Contours With 11 Additional Air Carrier and 25 Additional Commuter Flights
Long Beach Airport Terminal Improvement EIR

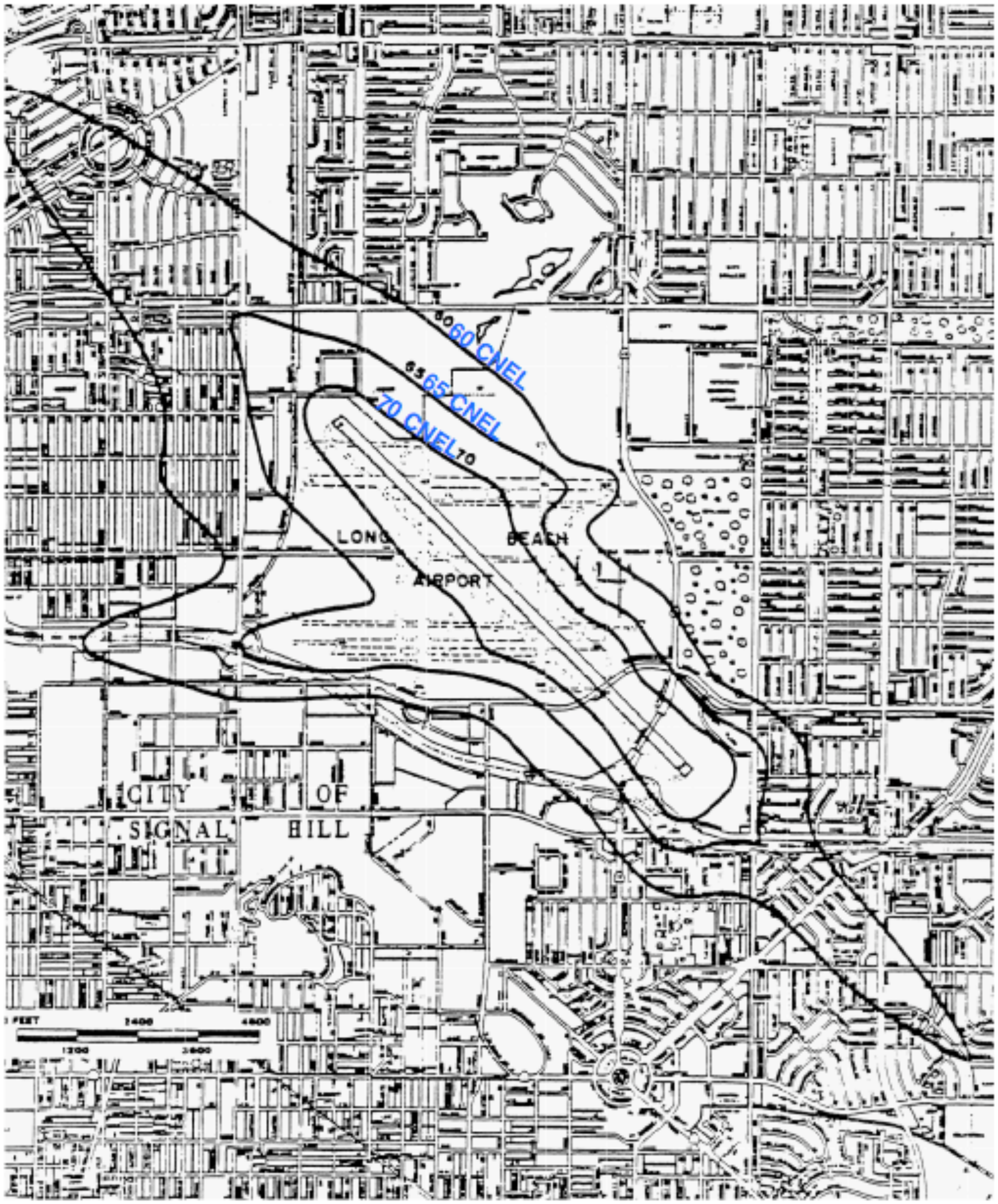


Exhibit 4-3
1985 Part 150 Noise Compatibility Plan Contours
Long Beach Airport Terminal Improvement EIR

4.6 SHORT TERM CONSTRUCTION NOISE IMPACTS

Construction noise represents a short-term impact on ambient noise levels. Noise generated by construction equipment, including trucks, graders, bulldozers, concrete mixers and portable generators can reach high levels. For the proposed project, the highest noise generating activities will include construction on the main terminal to add additional gates and construction of additional parking facilities. None of these activities will occur in the vicinity of any noise sensitive land uses. The closest homes to the construction area are the homes east of the project site across Lakewood Boulevard and on the other side of the golf course. The nearest construction activity that will occur to these homes is the construction of the parking garage. The distance from the nearest edge of the parking garage to the nearest home is approximately 2,185 feet. Construction activities on Parcel 'O' are discussed at the end of this section.

Worst-case examples of construction noise at 50 feet are presented in Exhibit 4-3. The peak noise level for most of the equipment that will be used during the construction is 70 to 95 dBA at a distance of 50 feet. Noise levels at the nearest homes nearly 2,200 feet away are estimated using the loudest noise level for each type of construction equipment shown in Exhibit 4-3. For example, for a front loader the range of expected noise levels at 50 feet is from 72 to 97 dBA. For these estimates a worst case noise level of 97 dBA at 50 feet is assumed. The results of this analysis are shown in Table 4-4 for the loudest types of construction equipment. Note that the pile driver is not shown in the table because a pile drive will not be required for the type of construction this project.

Table 4-4
Maximum Parking Structure Construction Noise Levels At Homes Across Lakewood Boulevard

		Maximum Noise Level at Nearest Residence (1), dBA			
Equipment	reference at 50 feet	Spherical Spreading	Lateral Attenuation	Atmospheric Absorption	Max Noise Level
Front Loader	97	64.2	12.7	1.8	49.7
Jackhammer	99	66.2	12.7	1.8	51.7
Concrete Mixer	90	57.2	12.7	1.8	42.7
Crane	96	63.2	12.7	1.8	48.7

Notes: (1) distance of 2185 feet

The data in Table 4-4 were computed by taking the maximum estimated noise level at 50 feet and computing the noise level at 2,185 feet accounting for spherical spreading (the decrease in sound level with increasing distance), lateral attenuation (effect of ground absorption and ground reflection according to SAE AIR 1751) and atmospheric absorption (Handbook of Acoustical Measurement and Noise Control, 3rd Edition, Cyril Harris, McGraw-Hill, 1991).

The City of Long Beach does not set noise limits for construction, but does limit the hours of construction. However, construction noise levels estimated here can be compared to the City of Long Beach Municipal Noise Ordinance to determine if there will be short term noise impacts. These limits were shown in Section 3.2. A daytime noise may not exceed 50 dBA for more than 30 minutes in any one hour or a maximum of 70 dBA (there are limits for other exposure times and these are described in Section 3.2). All of the construction activities will meet the Long Beach noise ordinance during daytime hours. Nighttime construction activities will not cause the noise levels to exceed the 45 dBA (for more than 30 minutes) night noise limit (65 dBA Lmax) as specified in the City code. Night construction activity at the terminal building area will meet night time noise limits.

It should be further noted that the trucks hauling cement and gravel will not use local residential streets to access the site. All such vehicles will use the 605 Freeway to the 405 Freeway and Lakewood Boulevard to access the site. This route has been used during other airport construction projects to minimize construction traffic and noise impacts on the community.

Parcel ‘O Construction Activities

The construction activities on Parcel O would be limited. No structures would be required. This area would potentially operate as a temporary parking lot while the parking structure is being constructed, then as tie-down and small hangars for general aviation aircraft. Construction activities would include some clearing, leveling, paving, construction of hangars,and minor improvements such as security gates and lighting. The closest existing houses to this area are the homes east of Clark Avenue, which are approximately 275 feet away at the nearest point of Parcel O. However, since construction would not occur on the narrow "panhandle" portion of the parcel, the closest construction would be approximately 1,000 feet away from the nearest residents. Additionally, a berm is located along Clark Street that provides approximately nine dBA of attenuation to the nearby residents. The noise level estimated for the homes nearest Parcel O (across Clark from the airport) is approximately 55 dBA Lmax (daytime limit is 70 dBA) and an average noise level in the range of 45 to 50 dBA (daytime average noise limit is 50 dBA – average noise levels are estimated to be 5 to 10 dB less than the maximum noise level). During daytime hours the traffic noise on Clark Avenue will mask the construction noise and no significant impact is anticipated.

Table 4-5 shows the estimates of construction noise levels associated with construction on Parcel ‘O.’

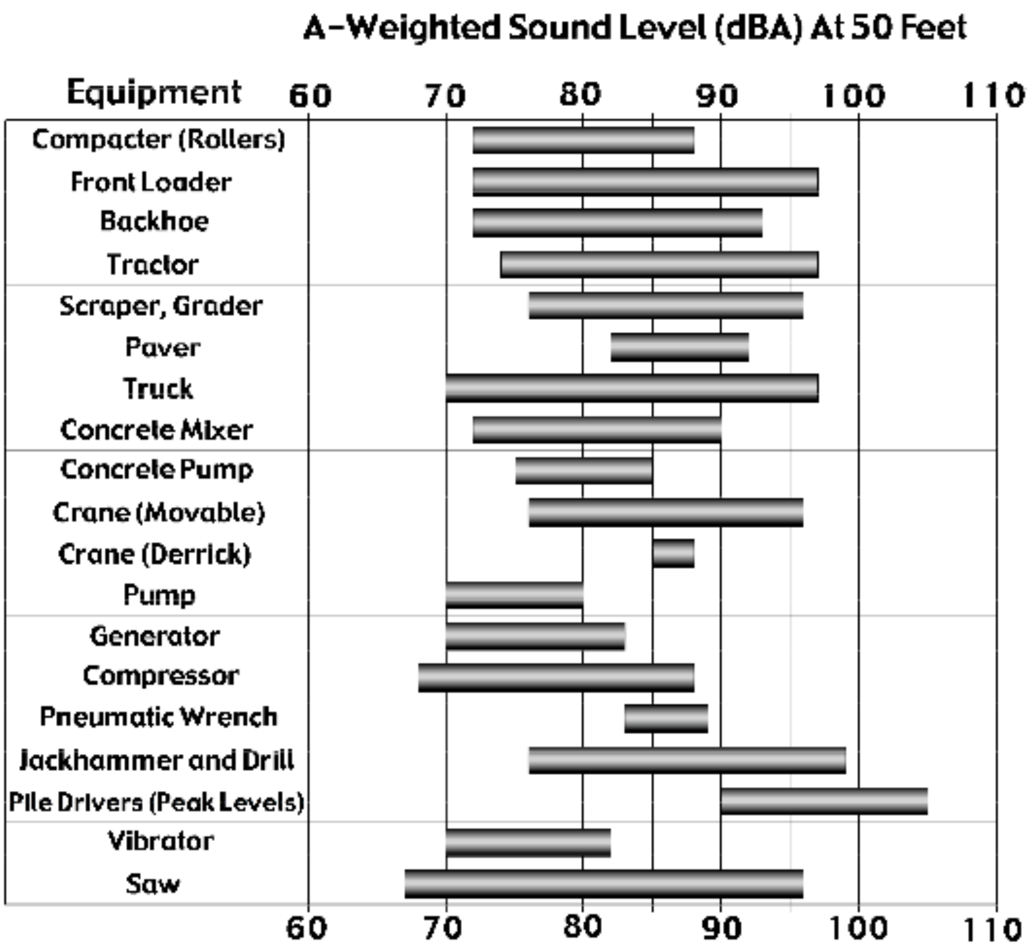
Table 4-5
Maximum Parcel 'O' Construction Noise Levels At Homes Across Clark Avenue

		Maximum Noise Level at Nearest Residence (1), dBA			
Equipment	reference at 50 feet	Spreading and Berm	Lateral Attenuation	Atmospheric Absorption	Max Noise Level
Front Loader	97	62.0	8.5	0.8	52.7
Jackhammer	99	64.0	8.5	0.8	54.7
Concrete Mixer	90	55.0	8.5	0.8	45.7
Crane	96	61.0	8.5	0.8	51.7

Notes: (1) distance of 1000 feet

Work would be done primarily during weekday daytime hours and noise levels will be consistent with the requirements of the Long Beach Noise Ordinance (even though construction noise is exempt from the noise ordinance during weekday daytime hours).

Night Construction activity on Parcel O may result in noise levels in excess of the noise levels specified in the Long Beach Noise Ordinance. This would apply to heavy truck activity, front loaders, tractors and other such heavy equipment that is usually associated with grading and paving and would occur only while such equipment is operating at the point of Parcel ‘O’ nearest the residences across Clark Avenue. Other construction activity such as striping, assembly of prefab metal hangars, fencing or other light construction activity can be done at night and meet the night noise level limits of the noise ordinance.



Source: **"Handbook of Noise control," by Cyril Harris, 1979**

Exhibit 4-1
Typical Construction Noise Levels
Long Beach Airport Terminal Improvement EIR

5.0 POTENTIAL NOISE MITIGATION MEASURES

This section describes measures that have the potential to mitigate noise impacts from the project case scenarios and alternatives. Noise mitigation can address any or all of the following three components of a noise impact problem:

- the noise source
- the sound propagation path
- the receiver

Mitigation at the noise source includes controlling noise through restrictions on sources, engineering noise controls, relocating the noise source, or limits on the operations of the source. Mitigation of the sound propagation path includes the construction of noise barriers or improvements in building construction. Mitigation at the receiver includes relocating the receiver or restrictions on the location of receivers (land use controls).

5.1 AN INTRODUCTION TO MITIGATION MEASURES

This section analyzes a full range of potential aviation noise mitigation for Long Beach Airport and discusses their applicability to the project case scenarios and alternatives.

Because of the complexity of the roles of the airport proprietor, the federal government, state government and local municipalities, aviation noise mitigation is a complex subject. Generally, the responsibility and authority for noise abatement mitigation measures does not rest with one individual, one governmental entity or agency, or one community. To the contrary, the authority and responsibility lies with a wide variety of federal, state, local and private entities and corporations, both on a national and local level. A coordinated approach to noise abatement and the occasionally difficult task of resolving noise impacts was outlined in the Department of Transportation/Federal Aviation Administration (DOT/FAA) Noise Abatement Policy of November 18, 1976. The need for noise compatibility programs has been recognized since that time through passage of the Aviation Safety and Noise Abatement (ASNA) Act in 1979, the statutory authority for Federal Aviation Regulation (FAR) Part 150. The Airport Noise and Capacity Act of 1990 established a definitive schedule for the replacement of older noisier aircraft while limiting the ability of airport proprietors to establish new airport access restrictions.

The Federal government has the authority and responsibility to control aircraft noise sources, implement and enforce flight operational procedures and manage the air traffic control system in ways that minimize noise impacts on people. State and local governments have the responsibility to provide land use planning, zoning and development controls that will encourage development or redevelopment of land that is compatible with both present and projected airport operations. In order to accomplish this task, the state must provide enabling legislation that grants authority to the local units of government to implement land use controls that are not confiscatory or discriminatory. In addition, the local units of government having land use control must work closely with airport management to coordinate land use compatibility planning beyond the airport's boundary. Sometimes, the airport operator has no authority to control the types of land uses outside the airport ownership boundary and must therefore work cooperatively with the appropriate local unit of government.

Noise standards for individual aircraft are established by the Federal government and must be met by the aircraft manufacturers through newly designed engines and aircraft. The airlines are then responsible for replacing or retrofitting their fleet with these new aircraft and/or engines.

The Airport Management is responsible for planning and implementing airport development actions designed to reduce noise. Generally, such actions include improvements in airport design and noise abatement ground procedures, in addition to evaluating restrictions on airport use that do not unjustly discriminate against any user, impede the federal interest in safety and management of the air navigation system, or unreasonably interfere with interstate commerce. As noted, under Federal Aviation Regulation Part 161, such restrictions typically require FAA approval.

The objective is to explore a range of feasible alternatives of land use patterns, noise control actions and noise impact patterns, seeking optimum accommodation of both airport users and airport neighbors within acceptable safety, economic and environmental parameters. Consideration of alternatives addresses both physical planning and the implementation aspects of proposed solutions. Some alternatives may have little or no value in a particular airport situation, especially if used alone. In order to be considered for implementation an alternative should:

1) have the potential of resolving a recognized problem;
2) be implementable within acceptable economic, environmental and social costs; and
3) be legally permissible within existing state, federal and local legislation, regulations, and ordinances.

This section contains a description of *potential* noise abatement measures or actions for the reduction of noise levels associated civilian aircraft operations at Long Beach Airport. A general evaluation of each is made on the basis of the three factors listed above, and will be presented in three different categories:

a) those alternatives generally considered available to the airport proprietor;
b) those alternatives available to the state or local unit of government; and
c) those alternatives dependent upon Federal government concurrence for implementation.

The list of mitigation measures presented here for evaluation was developed from FAR Part 150 guidelines ("Noise Control and Compatibility Planning for Airports," AC 150/5020-1, 1983).

5.2 AIRCRAFT NOISE MITIGATION OPTIONS AVAILABLE TO THE AIRPORT PROPRIETOR

Note that the following list of potential mitigation measures available to the airport proprietor were taken from the FAR Part 150 Guidelines that were developed prior to the adoption of the Airport Noise and Capacity Act (ANCA). While new guidelines have not yet been adopted, this list is provided as a guide to the reader. However, ANCA serverely limits the airport proprietor in terms of any noise mitigation measure that would limit access to the airport (see Section 1.6).

Denial of Use of Airport to Aircraft Not Meeting FAR Part 36 Stage 3 Standards.

This alternative limits access to the airport to aircraft that conform to certain FAR Part 36, Stage Three, and noise level requirements. Older, noncomplying (Stage Two) turbojets would be denied or given only restricted access to the airport.

Denying such aircraft use of the airport prior to the date required by the Federal statute is a feasible option provided the action is not unjustly discriminatory, does not constitute a burden on interstate and foreign air commerce, does not conflict with any airport policy or requirement, and is compliant with the requirements FAR Part 161. Federal law required the elimination of Stage 2 aircraft over 75,000 pounds maximum gross takeoff weight from domestic operations by the year 2000 and all domestic airlines in the contiguous 48 states are in compliance. Therefore, this measure is inapplicable to the proposed project, and no Stage 2 scheduled commercial operations are forecast for LGB under the proposed project case scenarios, no project or project alternatives.

Capacity Limits Based on Noise.

Historically restrictions on airport use have, in certain limited instances, been based upon noise limits. The form of such restrictions can take three broad forms of implementation. These are outlined below.

Restrictions Based on Cumulative Impact. With this alternative, a maximum cumulative impact (such as the total area within the existing CNEL 65, 70 or 75 dB contour) is established as the base line cumulative impact and then the airport's operations are adjusted or limited so as not to exceed that maximum in the future. This is accomplished through "capacity limitations", whereas either the aircraft types, based upon their "noisiness," or the numbers and mix of aircraft, or the time of operations are limited or adjusted so as not to exceed the existing noise impact. This approach is sometimes referred to as a "noise budget" regulation. No commercial air carrier airport in the United States, other than Long Beach, has ever implemented a regulatory restriction of this type. This type of regulation is the basis for the existing LGB Noise Budget.

Restrictions Based on Certificated Single Event Noise Levels. Most aircraft today have been certificated for noise by the FAA, as part of the FAR Part 36 process explained earlier. These levels are published as part of the Advisory Circular 36-1C and 36-3G, and it is possible to devise limitations based upon those certificated data. This alternative can be formulated so as to set a threshold noise level for the airport which cannot be exceeded, or different levels can be implemented for either day or night operations. An aircraft's compliance with this limit would be determined from the published FAA certification data. However, certificated levels are not always representative of actual operational noise levels of any given airport or for any specific flight. For this reason the City of Long Beach has rejected this form of regulation at LGB, relying instead on actual measured noise levels rather than certificated levels.

Restrictions Based on Measured Single Event Noise Levels. Although aircraft noise levels vary widely with changes in operational procedures, as well as with atmospheric conditions, it is possible to set limits on measured single event noise levels. Aircraft that exceed this limit can be prohibited from using the airport. However, these measures have been severely limited by the 1990 ANCA and, unlike the existing Long Beach regulations, all of which were adopted before 1990, any new more restrictive regulations applied to LGB may now require a Part 161 application for implementation.

Landing Fees Based on Noise.

This alternative is based on the premise that all or part of the landing fee for each aircraft focuses on the noisiness of that individual aircraft. This would apportion the "cost" of producing the noise to those aircraft that contribute the most to it. This measure would be implemented to encourage the use of quieter aircraft while generating additional revenue for the airport. In order to avoid unlawful discrimination, the FAA has suggested that the noise fee should be based upon a published standard for single event noise levels, such as those contained in Advisory Circular 36-3G. As a corollary to this, the opposite strategy can also be used. That is, quieter aircraft could be apportioned a lesser fee than noisier aircraft, thus serving as an incentive for quieter aircraft. In this manner, airlines that go to extra lengths to reduce noise generated by their aircraft are rewarded. In effect the theory of this type of approach is to create "market incentives" to "encourage" use of quieter aircraft.

This alternative has never been successfully implemented primarily because any feasible price differential would be inconsequential to airline operating costs and there is no guarantee that noise will be reduced.

Complete or Partial Curfews.

Airport curfews are an effective but costly means of controlling noise intrusion into areas adjacent or in close proximity to the airport. Curfews can have a very significant negative economic effect upon airport users and those providing airport-related services. The issue is sometimes articulated as a concern of unjust discrimination or as an unreasonable burden to interstate or foreign commerce. A curfew can take various forms, from restrictions upon some or all flights during certain times of the day or night, or restrictions based upon noise thresholds and certificated aircraft noise levels contained in the AC 36-3G. Curfews are usually implemented to restrict operations during periods when people are most sensitive to noise intrusion, which most often occurs between the hours of 10:00 or 11:00 pm to 6:00 am or 7:00 am. Again, generally, implementation of these measures as a new restriction has been severely limited by the 1990 ANCA and may require a Part 161 application for implementation.

LGB has night restrictions in place. These are described in Section 1.6.

Noise Barriers (Shielding).

Noise generated from ground-level sources on an airport can be a result of engine run-up and maintenance operations, taxiways and warehouse activities. Noise intrusion from these sources is usually only significant to those areas in close proximity to the airport. One method of mitigating this type of noise is through the use of noise barriers or earthen berms. These can protect immediately adjacent areas from the unwanted noise generated by aircraft still at ground level. Once the aircraft is airborne these measures have no effect.

Another method is through the strategic and well-planned location of airport structures that can provide shielding to adjacent areas to prevent noise intrusion. Run-up and maintenance areas can also be moved to areas which are away from noise sensitive uses adjacent the airport, and if necessary “hush houses” can be constructed to absorb sound for run-up and maintenance operations. Long Beach has a “noise berm” adjacent to the brake release area for its main airline runway, Runway 30.

Ban All Jet Aircraft.

This alternative is sometimes proposed at general aviation airports, but it has been well settled and documented by case law that this is not legally possible. The federal courts have held that a regulation based on an aircraft’s power plant rather than its noise level results in unjust discrimination in violation of the grant assurances required by the Airport and Airway Improvement Act of 1982, as amended. An outright ban on all jet aircraft, especially at an air carrier airport, cannot be legally implemented.

Acquisition of Land or Interest Therein.

The most complete method to totally control and mitigate noise intrusion is to purchase the impacted property in fee simple, but it is also the most costly and it may remove the property from the tax rolls of the community. It can also disrupt existing communities. However, certain land areas are more critical than others and can be purchased to mitigate severe noise intrusion and purchase of the full or partial interest may be the only means of achieving compatibility. One method of keeping the area on the tax rolls is to purchase the property and then resell it for a compatible use or to resell it for residential use but retain a portion of the “bundle of rights” that are part of property ownership. In other words, the airport can resell the property to the original homeowner or anyone else, but retain a covenant or easement that identifies the airports right to fly over the property and to create noise. This results in the property owner giving up his/her right to initiate litigation against the airport for noise intrusion. In addition, this method allows the market to set the price and value of the noise easement that is retained by the airport. The airport could also develop or resell the property to another government agency to develop it as a compatible use (golf course, nature area, cemetery, etc.), or the agency could purchase the property outright for their own use. This would have to be coordinated with the local community and airport management to ensure redevelopment with a compatible use. This alternative is meaningful only where airport noise exceeds community noise criteria.

An alternative to purchasing land in fee simple is to purchase an easement, which is the right to do something (positive easement) or the right to preclude the owner of the rest of the property from doing something (negative easement). An easement is sometimes preferred because it keeps property on the tax roles, but many times it costs as much as the entire fee. There are two main types of easements associated with airports, the clear zone easement and a noise easement that was discussed in an earlier paragraph. Easements can be purchased, condemned or dedicated through the subdivision process. No matter what interest of land is purchased, if federal assistance is used, the provisions of the Uniform Relocation Assistance and Real Property Acquisition Policy Act of 1970 (URARPAPA, PL 91-646) must be followed.

Sound Insulation Programs

As part of the easement acquisition process described above, airport proprietors may institute a program to install sound insulation in homes and others uses such as schools located in high noise impact areas. Typically the airport provides replacement doors and windows, ventilation systems and other sound insulating construction. The airport proprietor generally installs the insulation in return for an avigation easement. The cost of these programs is sometimes funded from the proceeds of the Passenger Facility Charge (PFC) upon approval of the FAA. Additional funding sources include AIP Grant funds, LGB revenues and financing (bonds). It is important to note that currently an airport cannot use AIP funds for sound insulation for homes with noise exposure less than 65 CNEL.

Typically, sound insulation programs are directed towards property within the 65 CNEL contour. However, recent efforts to insulate homes within the 60 CNEL contour have been proposed. Funding for such programs has been the critical issue and it remains to be seen if such programs will be successful.

Construct a New Runway in a Different Orientation.

Many times the construction of a new runway with a different orientation will shift impacts away from noise sensitive uses to less populated areas. The orientation of a runway is dependent upon many factors, including prevailing winds, topography, obstacles and other conditions. A new runway cannot be constructed if wind direction and topographic conditions are such that safety criteria cannot be met. New runways are not recommended as they would provide no noise exposure benefit around LGB.

Runway Extensions.

Many times a runway extension, coupled with other noise abatement procedures can mitigate noise impacts on areas in close proximity to the airport. The extension can allow aircraft to gain altitude quicker relative to surrounding land uses and produce less noise impact at ground level. In addition, noise abatement turns are sometimes possible with an extension as a result of enhanced altitude position. Many times, with an extension, the area off the end of the runway with an extension can experience greater amounts of noise due to lower approach altitudes at this end of the runway. This can sometimes be corrected by establishing a displaced threshold so that aircraft land farther down the runway and maintain altitude over the area beyond the extension. This practice is not generally recommended by the FAA. An additional factor to consider with a runway extension is that many times heavier, larger aircraft can be accommodated at the airport that were unable to operate in a safe manner previously. This may not necessarily be undesirable, however, for many of the larger, heavier aircraft are new generation aircraft and are actually quieter than certain smaller or older aircraft. In addition, they are capable of handling a larger seating capacity that may actually reduce the overall number of operations occurring at the airport. This could result in an overall reduction of noise intrusion. Runway extensions can also be used as a noise abatement measure to help reduce the need for using reverse thrust upon landing, which can generate a considerable amount of ground-level noise to areas in close proximity to the airport. LGB already has displace landing thresholds for noise abatement purposes, and runway extensions would not be practicable within existing property boundaries.

Touch and Go Restrictions.

Restrictions on training flights performing touch-and-go operations can mitigate noise impacts at airports where there are a significant number of such operations, especially jet training. This alternative is also effective if the operations are occurring during the nighttime and early morning hours, for the restriction may be for certain time periods. LGB currently restricts touch and go operations (as well as stop and go, low approach, and practice missed approaches) to the hours of 7 am to 7 pm on weekdays and 8 am to 3 pm on weekends and holidays. In addition, except for instrument training, training operations shall be conducted on Runways 25L/7R, 25R/7L. or 34R/16L only.

High Speed Taxiways.

High speed taxiways can help reduce noise intrusion by allowing aircraft to exit the runway quicker and reducing the need for extended use of reverse thrust. During the recent rehabilitation of the Runway 12/30 key intersections were improved to facilitate higher runway exit speeds.

Noise Monitoring Program.

Noise monitoring programs can enhance the effectiveness of noise compatibility programs. While noise monitoring systems do nothing to directly reduce noise levels, these systems are tools to be used as part of a noise management program. Historically, continuous noise monitoring systems are part of aircraft noise abatement programs at airports experiencing severe encroachment that have been pressured to demonstrate how they were reducing noise impact. The noise monitoring of aircraft operations is a means of showing concern and progress toward reducing a problem. Most of the systems have several remote microphone units that sample the weighted sound level, code the samples, and transmit the data to a minicomputer system with printouts. Any FAA approved noise monitoring system would have the following minimum capabilities to provide: continuous measurement of dBA at each site, hourly Leq data, daily CNEL data, and single event maximum A-weighted sound level data. In addition, state of the art noise monitoring systems have the ability to track and plot aircraft position through direct or indirect connection to the FAA radar system. LGB recently upgraded their noise monitoring system with the latest state-of-art technology. The upgrade includes replacement of each of the exiting 18 noise monitors, installation of a new long-range radar system, which will provides accurate and more readily accessible noise detection and flight identification information.

LGB's noise monitoring program and its noise ordinance are recognized as one of the sophisticated and restrictive program in the world.

Noise Complaint/Citizen Liaison Program.

A comprehensive noise complaint handling system/program should have two components; one to address the users and potential violators and one to address the concerns of those impacted by the noise occurrence. The noise complaint program should provide for the identification, notification and training of aberrant pilots, public accessibility, data collection to identify sensitive areas and positive public relations.

The noise office should maintain a database of each complaint noting the time, place, type of complaint, type of aircraft and N-number or other identifying characteristic of the aircraft. This information would thus be used to identify problem areas, noise violators, and when appropriate assess monetary fines.

The airport noise abatement office should be structured to handle noise complaints from citizens. The airport should have a central location to lodge noise complaints and gain information concerning aircraft operations or changes in flight procedures. Complainants should have the option to submit complaints via phone, written correspondence, fax, and electronically (email). Information on aircraft operations or changes in flight operations should be obtainable through verbal communications, written format and electronic media, i.e. websites and the internet.

LGB has a well developed Public Affairs and Noise Office that receives and responds to noise complaints. Additionally, they have implemented an extensive public information and outreach program.

LGB Airport users have formed the Aviation Noise Abatement Committee, comprised of airport users, businesses and Airport staff, which provides information that encourages aircraft operators to implement and utilize noise abatement and fly quite procedures.

5.3 OPTIONS AVAILABLE TO STATE/LOCAL GOVERNMENT

Land Use Controls.

Land use and development controls that are based on a well defined and thoroughly documented comprehensive plan are among the easiest and most powerful tools available to the local unit of government to ensure land use compatibility. It is very important for the local unit of government to exercise these controls, for these controls are beyond the authority of the airport management to implement, and it is the responsibility of the local unit of government having land use jurisdiction to implement these controls to protect the airport from encroachment. Traditionally, even if the airport is managed by the same unit of government that has land use control authority for the land area beyond the airports boundary, there has been little coordination and discussion as to what land use controls should be implemented and which land uses are compatible with airport development. This is very important and cannot be overemphasized to ensure coordination of development plans for all parties involved. This is particularly important where more than one unit of government has land use control authority for the area outside the airport's boundary. The airport is in a particularly precarious position, because the airport is liable for noise intrusion but has no authority to control what types of land uses are developed beyond its borders. It is *extremely* critical that the local unit of the government accept responsibility for ensuring land use compatibility in their planning and development actions. It is also important that the state government provide the necessary enabling legislation that will allow the local unit of government to institute land use controls. The most common forms of land use controls available to the local governments include: zoning, easements, transfer of development rights, building code modifications, capital improvement programs, subdivision regulations and comprehensive planning. These forms of land use controls have all been discussed earlier in this report, with the exception of transferable development rights, and will only be briefly outlined in the following paragraphs.

Zoning. Zoning is the most common and traditional form of land use control used in the United States today. It controls the type and placement of different land uses within the designated areas. It is used to encourage land use compatibility while leaving property ownership in the hands of private individuals or business entities, thus leaving the land on the tax roles. Zoning is not applied retroactively and is not necessarily permanent. It is most effective in areas which are not presently developed and which can be encouraged to develop with compatible uses.

Easements. As stated earlier, an easement is a right held by one to make use of the property of another for a limited purpose. Two specific types of easements are usually referenced in airport planning, a positive easement that would allow the generation of noise over the land and a negative easement to prevent the creation of a hazard or obstacle on the property of another.

Transfer of Development Rights. The transfer of development rights involves separate ownership of the "bundle of rights" associated with property ownership. The concept involves the transfer of the right to develop a certain parcel of property to a certain density/intensity to another parcel of property under separate ownership. This would allow the property that obtains the added development rights to develop to an intensity/density that is beyond that which would normally be allowed. The airport could also purchase these rights from the landowner and retain them or sell them to another landowner. This concept can be used to retain property in compatible uses and still compensate the landowner for his loss of development. The idea depends on market conditions of the area and (there is some disagreement on this point) upon the availability of state enabling legislation authorizing the development of the concept at the local level.

Building Code Modifications. This alternative is to modify existing or potential building codes to include specific sound attenuation provisions for structures within areas impacted by aircraft noise.

Capital Improvements Program. This is a document that establishes priorities and costs on the funding and development of public facilities. It can be used very successfully, in concert with subdivision regulations and a comprehensive plan, to control not only the areas of development but the timing of development by controlling the timing and location of public facilities.

Subdivision Regulations. Subdivision regulations are used to control the design and placement of public and private facilities in the conversion of raw land to developed property.

Comprehensive Planning. Comprehensive future land use planning, when it is coordinated with the zoning ordinance, subdivision regulations and the capital improvements program, can reduce or avoid land use incompatibilities in the future.

All of the state and local jurisdiction land use controls have been implemented near LGB by the Long Beach and the neighboring cities based on the planning policy boundary created by the 1985 Airport Noise Compatibility Plan.

5.4 OPTIONS DEPENDENT UPON THE FEDERAL GOVERNMENT

Departure Thrust Cutback.

This alternative would involve the imposition of thrust cutbacks following take-off. Because of system-wide needs, each airline has developed its own standardized take-off procedure. This alternative is recommended where the airlines have the opportunity to utilize a different departure thrust setting and still be within safety limits as per the particular type of aircraft they are flying given the characteristics of the particular airport concerned. In addition, this alternative cannot be implemented without the direct concurrence of the Federal Aviation Administration and compliance with Advisory Circular 91-53A. A tradeoff is always part of noise cutback procedure because the cutback, while reducing thrust and noise over one area will result in slower climb rates and hence more noise over other areas. This presents opportunities only where the area to receive more noise is not noise sensitive land uses. LGB is surrounded by residential uses that present no such opportunity. No changes in the LGB departure procedures are proposed as part of this project because such cutback procedures, while providing noise benefit in one area would increase noise levels in other areas.

Flight Track Alterations

This alternative involves routing take-off or approach flight tracks to minimize noise exposure on sensitive areas. These procedures are dictated by considerations of operational safety and air traffic control procedures. Generally speaking, the air traffic control procedures can be resolved, perhaps with penalties involving reductions in airport and airspace capacity. However, aircraft turns at low altitudes, where the aircraft are in a low-speed, high drag configuration, can cut deeply into aircraft operating margins. Turns during the last three to four miles of the final approach in good weather, and within the final six to seven miles during poor weather, are undesirable because they do not allow pilots to establish and maintain a stabilized approach. Aircraft bank angles near the ground need to be restricted to no more than 15-20 degrees. The FAA has published Advisory Circular 91-53-A regarding noise abatement departure procedures (NADP). AC 91-53-A sets minimum requirements for departure procedures and limits the number of NADP's that an airline may use. Again, these procedures cannot be implemented without the concurrence of the Federal Aviation Administration, taking into account both operational, safety and airspace considerations. Given that LGB is surrounded by residential areas, flight track alterations would produce no net gain in noise impact reduction and would result in moving noise from one residential area to another.

Preferential Runway System.

This alternative involves the use of runways that minimize noise impacts. The FAA is responsible for implementing this program based on the recommendation of the airport operator and the safety considerations contained in Federal Aviation Regulations Part 121.

There is only one runway available to jet aircraft at LGB, except during construction or maintenance of the main runway. The runway use (north or south flow) for that runway is determined largely by the prevailing wind. Due to the proximity of homes at both ends of the runways at LGB there is little benefit to a preferential runway program at LGB.

Power and Flap Settings.

A variety of operating procedures are possible for implementation at an airport. These include minimum flap landings and delaying flap and gear deployment. To help minimize fuel cost and flight time, most operators of large air carrier aircraft have adopted procedures for reduced flap setting and delaying flap and gear deployment, consistent with safety and current aircraft and flight crew capabilities. During Visual Flight Rules (VFR) weather conditions and low traffic conditions, air carrier aircraft generally land with minimum flap settings at an airport. More extensive delayed flap procedures have not been considered safe with current air traffic control procedures and safety criteria.

GPS Landing System.

A landing system based on Global Positioning Satellites is a new type of instrument landing system which, when fully installed, may allow noise abatement landing procedures which are not possible presently. This system is not yet fully serviceable, and it unknown when this system will be available for instrument flight rules. Also, benefits at LGB would be negligible based on the fact that there are residential and other noise sensitive land uses under all existing or potential runway approach/departure flight tracks. Therefore, no recommendations concerning such a system will be included in this study.

5.5 MITIGATION MEASURES RECOMMENDED FOR FURTHER CONSIDERATION

Existing aviation noise and potential future with optimized flight levels noise levels include homes within the 65 CNEL contour. Potential future aviation noise with optimized flight levels also includes 2 schools within the 60 CNEL contour. These impacts are either existing impacts or are impacts associated with the full realization of all the flights permitted in the airport noise budget. The realization of the additional flights permitted in the noise budget in not dependent on this project. In other words, realization of the airport noise budget will result in significant noise impacts, and the implementation of this project does not result in significant noise impacts. In other words, the impact of full implementation of the Noise Budget will result in noise impacts with or without this project. For purposes of this analysis the mitigation measures addressing noise impacts caused by the full realization of all the flights permitted in the airport noise budget is addressed here.

The following noise control measures would mitigate aviation noise to an acceptable level:

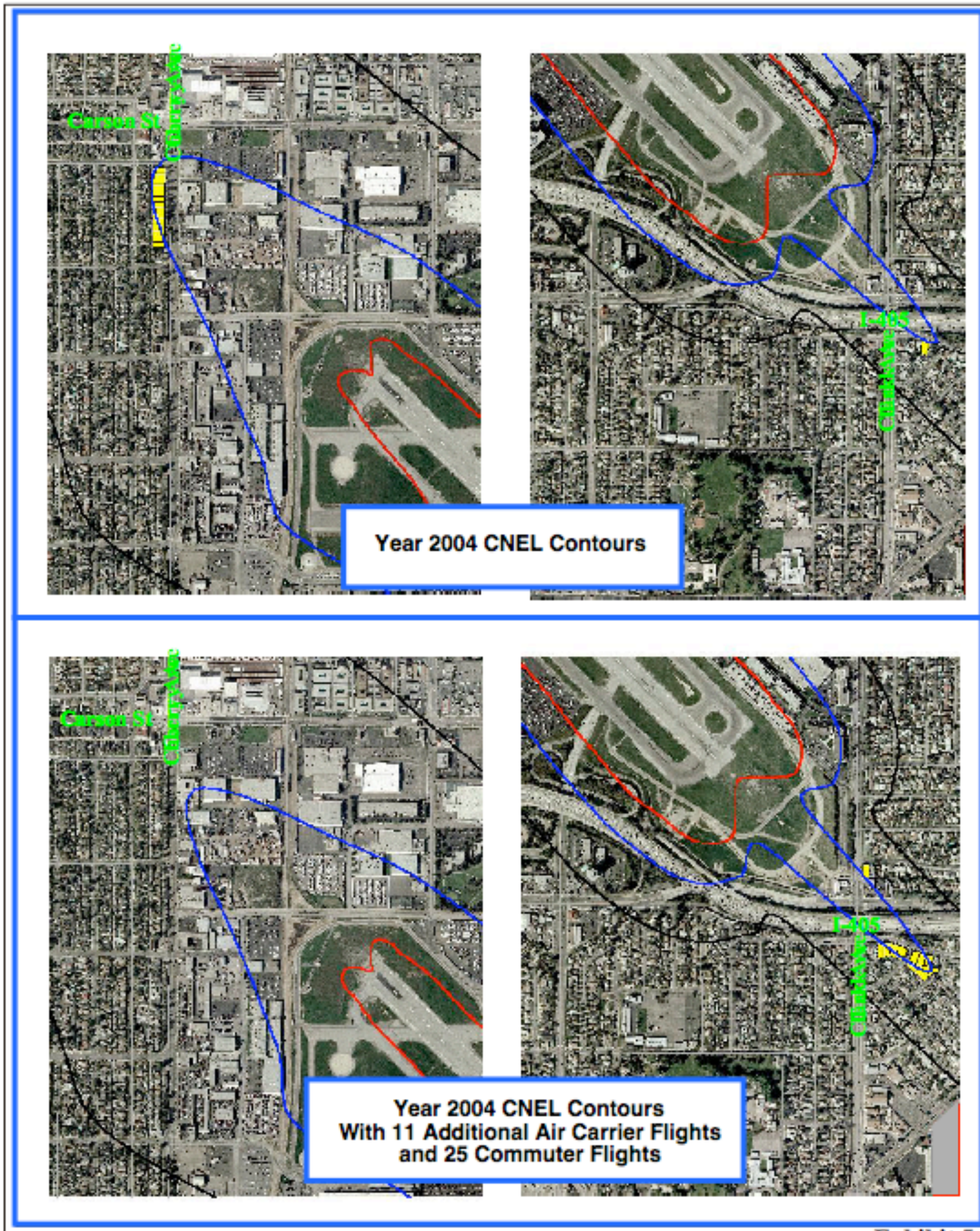
1. Sound Insulation Program For Homes Within 65 CNEL Contour
2. Sound Insulation Program For Schools within the 60 CNEL Contour

The homes within the existing 65 CNEL contour and potential future 65 CNEL contour are shown in detail in Exhibit 5-1.

There are no schools within the 60 CNEL contour for existing conditions. However, potential future with optimized flight levels noise levels show that full realization of the Noise Budget could cause 2 schools south of the airport to fall within the 60 CNEL contours. The school buildings used for teaching purposes located within the 60 CNEL contour are shown here in Exhibit 5-2. The 2 schools are as follows:

- Minnie Gant School on East Britton Drive
- Special Education Building located at the School Safety and Emergency Preparedness Offices of the Long Beach Unified School District located at 5250 Los Coyotes Diagonal.

It is recommended that the City of Long Beach develop a sound insulation program for these homes and schools. Such an insulation program would provide for replacing windows and doors with sound rated windows and doors and other building upgrades that will ensure an interior noise level that is less than 45 CNEL.



CNEL_60
CNEL_65
CNEL_70
Residences inside CNEL=65

Exhibit 5-1
Residential Uses Within 65 CNEL Contour
(Existing and Potential Future With Optimized Flight Levels)
Long Beach Airport Terminal Improvement EIR

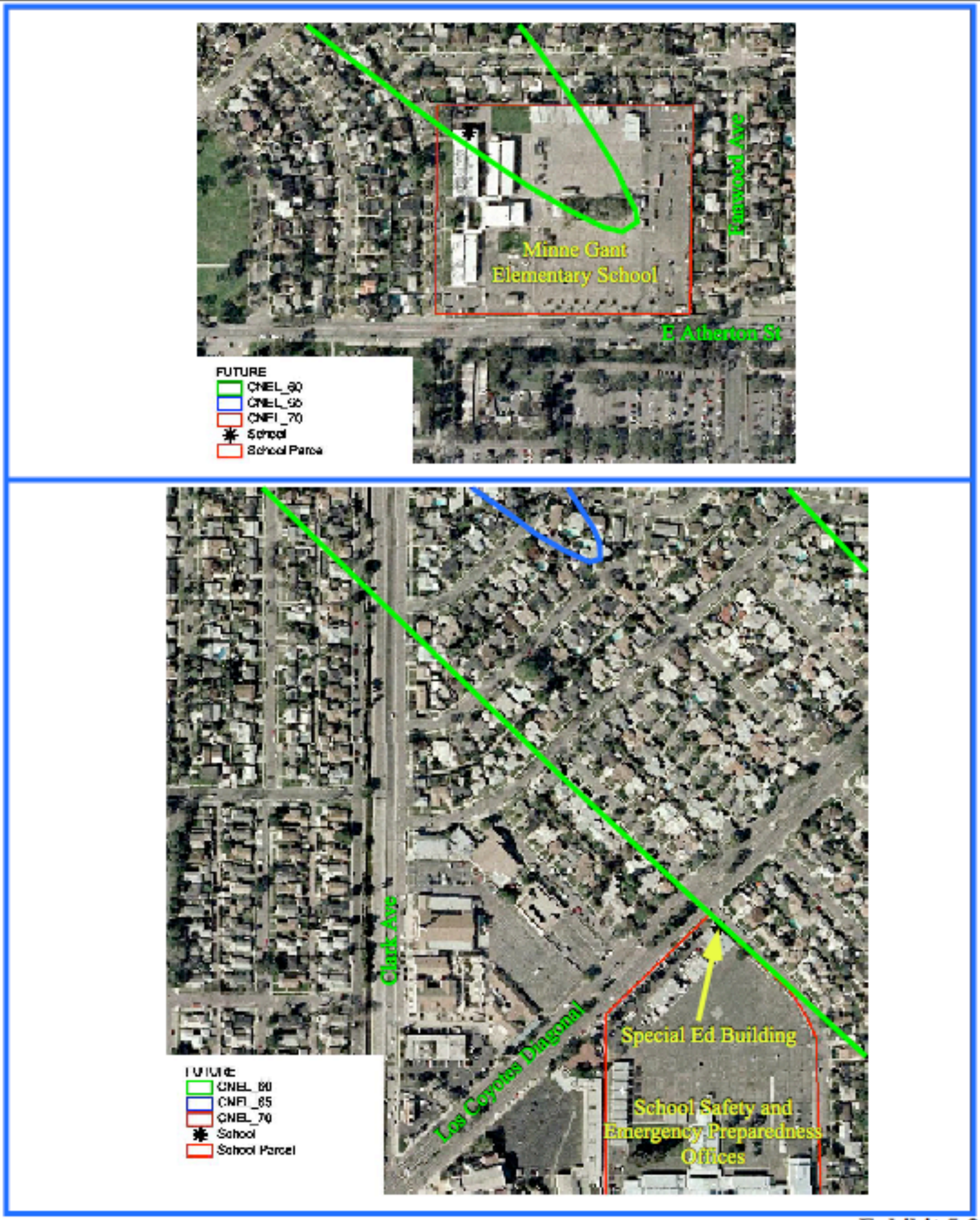


Exhibit 5-2
Schools Within 60 CNEL Contour
(Existing and Potential Future With Optimized Flight Levels)

* Note: There are no schools within existing 60 CNEL contour

Long Beach Airport Terminal Improvement EIR

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[14] Section 21675, Public Utilities Code.

[15] U.S. Department of Transportation, Federal Aviation Administration, "Integrated Noise Model (INM) Version 5.0 User's Guide," August 1995.

[16] Airport Environmental Handbook, Federal Aviation Administration Order 5050.4A, October, 1985.

[17] Acoustical Analysis Associates, Inc, 22148 Sherman Way, Suite 206, Canoga Park, CA 91303

[18] Bolt Beranek and Newman, "Noise Compatibility Program", Appendix D, 1985, p D-32